

Sustainable Buildings: Pauley Pavilion 2017 Midterm Report

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Abstract

The goal of the Sustainable Buildings: Pauley Pavilion team is to the gather the materials necessary for the recertification of Pauley Pavilion under the LEED (Leadership in Energy and Environmental Design) version 4 Standards for Existing Buildings, Operations and Maintenance (EBOM). This quarter, we began the process by reviewing the credits that Pauley Pavilion earned when it was certified at the LEED Gold level under Version 2.2 standards for New Construction. Based on this review, we compiled a list of information and documentation to demonstrate Pauley's adherence to EBOM requirements. We then transitioned to the data acquisition phase by reaching out to our stakeholder Todd Lynch, Principal Project Planner for UCLA Capital Programs, as well as Katie Zeller, Sustainability Coordinator for UCLA Recreation Sport Venues and Event Operations. By working with Athletics, Capital Programs, and Facilities Management, we hope to continue to centralize the information necessary for the recertification process. With a primary focus on building energy use and improving energy efficiency, we organized energy use data in the Energy Star portfolio manager tool; also in progress is the analysis of recent utility records for Pauley Pavilion to begin demonstrating fulfilment of LEED requirements or identifying necessary improvements to reach recertification eligibility.

Introduction

Precedents and Context

Multiple Sustainability Action Research (SAR) teams have previously tackled issues of energy sustainability and green buildings at UCLA. The 2012 LEED Assessment Action Research Team worked with our current stakeholder Todd Lynch to raise campus-wide awareness of LEED certification milestones and the importance of sustainable buildings through methods such as educational posted panels (Bains, Josephson, et al. 2012). This project's education measures had a special focus on depicting how LEED certification is pertinent to UCLA and the University of California's sustainability goals. The 2014 Green Buildings team focused on gathering and compiling documentation to streamline the LEED certification process of residential buildings on campus (Hirashiki, Lai, et al. 2014). In continuing with this precedent, we as the 2017 Sustainable Buildings: Pauley Pavilion team broadened our original focus on the energy efficiency aspect of LEED in order to examine Pauley Pavilion through the complete set of LEED standards for Existing Buildings, Operations, and Maintenance, in comparison to its former New Construction certification. This project uses Pauley Pavilion as a case study to take a broader look at expanding UCLA's focus on sustainable buildings to include not only one-time certification of new construction or renovation projects, but also the recurring certification of operations and maintenance of existing buildings that ensures follow-up to address not only the installation of sustainable features but also the employment and impacts thereof.

A need for LEED EBOM

There are about 30 LEED-registered buildings across UCLA. Most of these buildings have been certified under LEED-New Construction (NC) and these efforts have been vital in upholding the vision of sustainability on campus. On the other hand, there is a lacking effort in certifying LEED-Existing Buildings (EB). Improving existing buildings often allows for a smaller carbon footprint and overall resource strain in comparison to new construction. Applying for LEED-Existing Buildings certification also helps ensure that the facility is being operated in accordance with practices outlined when the managing entity applied for accreditation under New Construction. Altogether, there is sufficient motivation to actively pursue LEED accreditation at Pauley Pavilion and other existing buildings on campus.

Similar Projects

The only other building at UCLA that is registered under LEED-EB is the Public Affairs Building. In 2008, it was mandated by the University of California (UC) Office of the President that all UC campuses must have at least one building that is LEED-EB certified. The Public Affairs Building was able to attain LEED accreditation by implementing numerous small retrofits, including a reduction in water consumption in its toilets, urinals and faucets. The water usage in the toilets was reduced from five gallons per flush (gpf) to 1.6 gpf. This was accomplished by implementing biodegradable liquid sealants. Efficient and inexpensive aerators were also installed in faucets to reduce flow.

Beyond UCLA, other campuses within the University of California have also achieved EBOM certifications for certain buildings, such as Bren Hall at University of California, Santa Barbara (Jacques, 2014). For university athletic facilities, examples are fewer and farther between; however, many collegiate athletic facilities are working to improve sustainability. For example, Stanford University has installed solar photovoltaic panels at Maples Pavilion in an effort to procure renewable and sustainable electricity ("Maples Pavilion," n.d.). The Ohio State University has a zero-waste policy at Ohio Stadium (otherwise known as the Horseshoe, with a seating capacity that exceeds 100,000 people), mirroring the efforts of UCLA's Zero Waste Pauley Action Research Teams of 2013 and 2014 ("Zero Waste at Ohio Stadium," n.d.). Both of these teams worked toward the goal of diverting 100% of waste generated in Pauley Pavilion away from the landfill and instead to composting or recycling facilities (Young, Zeller, et al. 2014 and Hampton, Murphy, et al., 2012). In addition, UCLA is a contributing member of the Green Sports Alliance, further indicating its commitment to sustainability in athletics ("Green Sports Alliance, 2017).

Methodology

Energy Star Portfolio Manager

Early on this quarter, our stakeholder Professor Todd Lynch recommended that we familiarize ourselves with Energy Star Portfolio Manager to use as a tool for analyzing Pauley Pavilion's resource use. Created by the Environmental Protection Agency, Energy Star Portfolio Manager is used to measure and track energy and water consumption as well as greenhouse gas emissions. It is also a platform to compare resource usage with similar buildings across the country. Once meter, utility and waste management data is entered, Energy Star can sort and help visualize the data to analyze consumption. It also calculates a summary score that ranges from 1 to 100 that measures a building's overall efficiency. A score of 75 and over is an above-average sustainable building and also represents the minimum score required to apply for any LEED credits in the Energy and Atmosphere (EA) category. In addition a LEED credit: EA-Optimizing Energy Performance can reward up to 20 points for an Energy Star score of 95.

Table 1. Points for ENERGY STAR performance		84	11
ENERGY STAR rating Points		85	12
76	3	86	13
77	4	87	14
78	5	88	15
79	6	89	16
80	7	90	17
81	8	91	18
82	9	93	19
83	10	95	20
L	1]		
Distribution of point	s awarded in LEED EBOM credit: E	nergy and Atmosp	here-Optimizing Energy Performance

ENERGY S ENERGY STAT	Portfolio Manager® Tech				
Broad Category	Primary Function	Further Breakdown (where needed)	Source EUI (kBtu/ft²)	Site EUI (kBtu/ft²)	
Entertainment/Public Assembly	Stadium	Indoor Arena			
		Race Track			
		Stadium (Closed)	-	45.3	
		Stadium (Open)			
		Other - Stadium	95.1		
	Other	Aquarium	- 65.1		
		Bar/Nightclub			
		Casino			
		Zoo			
		Other - Entertainment/Public Assembly			
Median energy use intensity for similar buildings.					

Energy Star also calculates the Energy Use Intensity (EUI) from a given site and source. Site EUI is based only on the utility data, which includes energy used on-site such as natural gas and electricity purchased from the grid. A more accurate representation of a facility's energy usage is Source EUI, which also takes into account the energy intensity used to obtain the electricity. For example, source EUI accounts for the losses incurred in the storage, transport and delivery of fuel to the building.

Weather-Normalized Source EUI (kBtu/ft²) ^{Why not} score?		Metrics Summary	Change Time Period		
		Metric	Dec 2015 (Energy 🖊 Baseline)	Apr 2016 (Energy 🦯 Current)	Change
Current EUI: (12.0% worse than medi	95.3 ^{dian.)}	ENERGY STAR score (1-100)	Not Available	Not Available	N/A
		Source EUI (kBtu/ft ²)	97.2	95.3	-1.9(-2.0%)
Recoling ELU	97.2	Site EUI (kBtu/ft ²)	31.0	30.4	-0.6(-1.9%)
(14.2% worse than medi		Energy Cost (\$)	Not Available	Not Available	N/A
Current Source Energy Use Intensity. (March 2017)		Total GHG Emissions (Metric Tons CO2e)	634.4	622.1	-12.3(-1.9%)
		Water Use (All Water Sources) (kgal)	2,797.7	3,072.2	274.5(9.8%)
		Total Waste (Disposed and Diverted) (Tons)	Not Available	Not Available	N/A
		Current Energy Star me	trics summary with	n utility data input	•

Currently, we have energy and water meter data inputs, along with overall utility costs from January 2015 to to August 2016. From the energy inputs, it can be seen that Pauley Pavilion's EUI is higher than the median value for similar buildings. We have also noticed that a surprisingly large portion of the utility bill stems from using chilled water to cool the building. We are still in process of understanding the utility data and we are actively trying to troubleshoot the problem areas for resource usage.

Reconciling Credits

In order to begin reconciling LEED credits, our stakeholder Todd Lynch provided us with two key documents: Pauley Pavilion's Final LEED Scorecard for New Construction and LEED v4 Standards for Building Operations and Maintenance. The LEED Scorecard contained a brief description of all the prerequisites and credits associated with Pauley Pavilion's LEED Gold certification under LEED v2.2 for New Construction listing and whether they were earned or denied. After reading an additional document from our stakeholder which provided us with a better understanding of the points listed on the LEED Scorecard, our team began to analyze Pauley Pavilion's LEED credits. Our goal was to compare current LEED v4 (EBOM) standards with the LEED Scorecard associated with Pauley Pavilion's recent renovation and identify the credits that overlap. This allowed us to shift our focus from credits that were likely already met to the more-demanding new or modified credits and prerequisites. Our task required that we immerse ourselves in all the details of current LEED requirements. LEED v4 (EBOM) is divided into 6 categories: Location and Transportation, Sustainable Sites, Water Efficiency, Energy and Atmosphere, Materials and Resources, and Indoor Air Quality. To facilitate data gathering we created an excel spreadsheet and assigned specific prerequisites and credits to each team member. Below is a snippet of a few of these prerequisites/credits and how we organized them.

Category	Pre-requisite/Credit	Team Member	Points	New Credit	Data Needed	Data Collection Needed	Comments	Documents
Location & Transportation	Alternative Transportation	Shannon	1-15	No (modified)	Transportation survey; alternative transporation rate; walk scores; bike scores	Survey of "occupants" (visitors?)	4 points earned in previous certification; sports arenas seem like a special case: refer to previous certificaiton specs	
Sustainable Sites	Rainwater Management	Erick	2-3	No (modified)	Compare Stormwater Management: Quality Control information with updated credit	Stormwater Management: Quantity Control section was not applied for in previous LEED		Previous LEED Stormwater Management: Quantity & Quality Control Plans
Water Efficiency	Outdoor Water Use Reduction	Adam	1-2	Yes (modified)	Outdoor irrigation data		If irrigation required, install submeter. if already installed, demonstrate water savings	Outdoor irrigation submeter data
Energy & Atmosphere	Energy Efficiency Best Management Practices	Anne	0	Yes	Energy audit under ASHRAE requirements; facilities O&M plan	Possibly - update previous energy audit and maintenance plan		1. ASHRAE Level 1 energy audit, 2. O&M plan
Materials & Resources	Purchasing - Lamps	lleana	1	Yes	Amount of mercury in lamps; if non lamps must be as energy efficient as those that have mercury	Average amount of mercury between indoor and outdoor lamps as well as hard-wired and portable fixtures	Average of 70 picograms of mercury per lumen-hour or less for all mercury- containing lamps.	Mercury amounts in lamps purchased; if no mercury-energy efficiency of lamps compared to lamps with mercury
Indoor Environmental Quality	Green Cleaning - Equipment	Esther	1	Yes	Inventory of exisiting interior and exterior powered cleaning equipment, (le. vaccum, scrubbing machines etc) purchased, leased or used by contractors	Not likely	40% of equipment must meet critera listed in this credit EBOMv4, and phase out plan developed for those that don't meet, with replacement that is environmentally preferable.	Inventory list of powered cleaning equipments purchased, leased and used by contractors.

We included columns for each prerequisite or credit and described whether it was a new requirement, the amount of LEED points it is worth, the data needed, and required documents. We also added columns to incorporate any additional comments or questions we had for our stakeholder regarding the specific item. Ultimately, we contacted our stakeholder Todd Lynch and Sustainability Coordinator Katie Zeller requesting the listed documents and clarifications regarding questions associated with particular LEED credits.

Data Collection

After compiling a list of necessary documentation, Katie Zeller shared Pauley Pavilion's utility consumption from January 2015 to August 2016 with the team. These records were prepared and initially sent to Katie by Spencer Middleton, Energy Analyst for UCLA Facilities. The utility records were specifically for consumption of chilled water, electricity, steam, and water. Electricity and water consumption were based on readings from multiple meters. The units for each utility were also provided by Spencer. We received monthly campus rates for each utility, meter location, and the amount of heating and cooling degree days. Unfortunately, some of the meters did not have measurements for months at a time, presenting a challenge for our

team, which is discussed in-depth in the following section of this report.

After receiving utility records, the team divided up the task of making graphs for both monthly consumption and cost for each utility. The team utilized a spreadsheet to organize the records and make bar graphs. Two bar graphs were made for each utility, one for consumption and one for cost derived from the rates provided. Since there are multiple meters for water and electricity, segmented bar graphs were created to show consumption per meter. Two out of the four water meters account for a small fraction of the total water measured, making these meters inconsequential. Line graphs were also created to relate temperature, chilled water, and steam to the amount of cooling and heating degree days. Steam and chilled water usage displayed sinusoidal activity with peaks occurring during the summer months. These peaks were especially prominent in steam consumption. The electricity consumption also rises and falls, but does so at a much faster rate in cycles of one to three months as opposed to seasons. Water consumption displays a similar trend, but is more difficult to confirm because of missing data. Degree days for the most part is inversely related to the average temperature (i.e. as the average temperature declines, there is an increase in the monthly amount of degree days and vice versa).

The next task is to compare our findings with values or standards set by other sustainable campuses. Our stakeholder suggested that we compare the records to benchmark-based whole building energy performance targets for UC buildings. Comparing Pauley Pavilion's records to these benchmarks will reveal its standing among buildings at other UC campuses. We are also trying to find out why some meters did not make measurements for months at a time. A trip to see each of the meters might be set up in the future to understand the meters better. After analyzing the data, the team will give recommendations on how to keep utility consumption low in order to fulfill requirements for LEED EBOM requirements for recertification. The graphs

will also be utilized to see where saving opportunities can be made in cost and consumption.



Below are some of the graphs our team has created based on the utility records provided.





Challenges and Difficulties

We have been fortunate to avoid any major setbacks in our project this quarter, but certain challenges have been more complex than others, and we have had to use creative problem solving skills to overcome them. One of the smaller but ever-present challenges we faced as a team was finding exciting, original photos for our blog posts. Although this may have been a straightforward task for other teams, we found creating interesting visuals that related to our research topic was more difficult than anticipated. Often, our blog posts highlighted the new things we were learning about LEED, energy consumption, and utilities, but we were not at a stage of hands-on research "in the field," so there were few obvious photo opportunities. When faced with this challenge, we spent time each week brainstorming as a team about what types of photos to include, using the creativity of the whole group to come up with our weekly ideas.

Another challenge emerged at the beginning of our research as we found ourselves entering an area of study that we were largely unfamiliar with. Because we had little preexisting knowledge about energy efficiency or the LEED certification system, our background research and initial literature review was daunting and overwhelming at first. We did not know where to start background research of a topic so broad, but we found that by researching general information about our topic we were left with questions that guided the rest of our research. By asking lots of questions and using our stakeholder as a resource for confusing topics, we were able to amass substantial background knowledge about our subject.

Through our preliminary research, we found that LEED is a multifaceted system with a scope much larger than energy. We found it challenging to formulate research questions and goals solely focused on energy, so we evaluated what we wanted our research project to encompass and decided to change the name of our team. Although energy is a big factor in the efficiency of buildings, our project goals depend on many other factors such as water use and utility metering, which are all aspects of sustainable buildings. Thus, we became *Sustainable Buildings: Pauley Pavilion*.

As we began the data collection process, we found that much of the initial data we sought

(such as utility data) already exists, but we were dependent on others to access it for us. Because this aspect of the research was out of our control, we sometimes felt powerless in making the process as straightforward as possible. We found that by communicating well with the people helping us gather data and being organized and specific about which data we needed, we were able to gather the data we needed for analysis in a timely manner.

Plans for Spring Quarter & Conclusion

We have a lot on our plate for Spring Quarter. Our primary objective is to provide recommendations for LEED re-certification at Pauley Pavilion. To achieve this goal, we outlined a series of intermediate steps and have begun executing them. We recently acquired utility records for Pauley Pavilion, with usage metrics for water, chilled water, electricity, and steam. With this data, we are looking to turn measurements into meaningful insights by charting consumption by meter of each energy source (independently and together) and comparing to University of California energy benchmarks as well as LEED EBOM conservation standards. Ultimately, this data will inform our team of how feasible it will be to achieve some of the Energy & Atmosphere credits in the LEED EBOM v4, which is necessary to build an attainment model. We expect to complete the utility records analysis within the first three weeks of Spring Quarter.

In constructing the attainment model, we are looking to identify the most economical pathways to achieve each of LEED Silver, Gold, and Platinum status. Credits will be classified in groups based on ease of achievability. We are still in the process of gathering documentation regarding cleaning practices, general building commissioning, and other policies in building operations. Once the model is complete, our team will offer recommendations pursuant to LEED re-certification and overall building sustainability. By then, we will also have applied for funding from The Green Initiative Fund (TGIF) to cover some of the costs of registration. While we are aware that the implementation of our suggestions is unlikely within the timeframe of next quarter, we are hopeful that consolidating the data and laying out the options will allow for a streamlined decision-making process.

One of our team's initial goals was to collaborate with Southern California Gas Company to complete an energy audit of Pauley Pavilion. We still intend to fulfill this goal. The energy audit will provide our team with a tremendous learning experience by way of observing best practices with respect to measurement, lighting, plumbing, and air quality. We will also get firsthand experience in the mechanical rooms, where we can learn about how steam and chilled water are used for heating and cooling. Lastly, by completing an energy audit we will have fulfilled two credits toward LEED re-certification. We are already in contact with the SoCal Gas Company and intend to complete the energy audit within the first half of Spring Quarter.

The last component to our busy second half is education. April is Earth Month, and we will be tabling on Earth Day to represent our team, SAR, and the importance of retrofitting existing buildings to become more sustainable. We are still working on coming up with an interactive activity to showcase at the Earth Day Fair. We would also like to add another educational component to our portfolio. Ideally, we would like to get air-time on some of the LED screens inside Pauley Pavilion to promote measures that enhance building sustainability. We are also thinking about posting signage during events at Pauley Pavilion, and other different ways to educate the UCLA community about sustainable buildings. All of these plans will become more concrete early in Spring Quarter.

Broadly speaking, our team is satisfied with the progress made thus far. We entered the quarter without much of an idea of how we were going to tackle the lofty goal of re-certifying

Pauley Pavilion under LEED EBOM. Through extensive research, internal discussion, and unwavering assistance from our stakeholder Todd Lynch and Katie Zeller, we were able to narrow the scope of our work and design a realistic, yet aggressive roadmap that will hopefully enable the ultimate decision-makers to adopt sustainable measures at Pauley Pavilion and swiftly apply for LEED re-certification.

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