



Environmental Studies Capstone 2016

Sustainable Infrastructure for the
Walzel Gymnasium: LED Lighting and
Recommendations for Future
Sustainability

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INTRODUCTION

In an effort to reduce energy consumption and advocate for sustainability at Southwestern University, an initial, comprehensive audit with Physical Plant was conducted to determine the facilities with the largest footprint on the campus' energy use. The Robertson Center Gymnasium has been the objective of prior Capstone groups and upon investigation our Capstone group found that the facility's aging infrastructure, in conjunction with it's sheer size and the cost of renovations, had been an insurmountable challenge in the past. In analyzing the efforts of previous projects to approach these issues, we found that the approximate price of updating Robertson's lighting in its entirety would have a cost upwards of \$100,000 (Schwartz, 2016). With such a high upfront cost, the project was considered too large for the university.

In response to this high cost, the approach taken with our project was to examine a smaller portion of the gym, perform a cost/benefit analysis, and utilize Green fund grants to fund a smaller portion of the total expenditure. These goals would allow us to produce tangible results that can be supplemented by further studies, as well as award the university the opportunity to renovate a portion of a large project at a relatively low cost. The knowledge gained during this project is presented within this document with the hopes that it will be of substantial value to students, faculty, and administration as Southwestern moves forward with its efforts to make itself a more sustainable and environmentally friendly campus of higher-education.

EXECUTIVE SUMMARY

In an effort to introduce more sustainable practices to Southwestern University's campus, this project will update the lighting in the Walzel Gymnasium to reduce energy load and increase efficiency. Specifically, this project is a student-organized, student-directed effort to replace Walzel's energy-inefficient incandescent bulbs with more cost-effective and dynamic LED lighting. The direct result of this transition will be a more secure and environmentally-friendly athletic space for Southwestern's students and student-athletes. Despite the fact that Walzel gym is only a small portion of the much larger Robertson facility, the proposed lighting changes to this gym are expected to generate enough savings for future capstone groups or the physical plant staff to reinvest those savings into more lighting improvements in Robertson over the next 2-3 years. This will ultimately cut the operational costs of this aging building, as well as serve as a springboard for future renovations.

In addition to implementing improved lighting in the Walzel Gymnasium, this project aims to further reduce energy consumption by making the 30 vending machines on campus operate more efficiently through the installation of two different products from the company EnergyMiser. These two devices, known as the SnackMiser and CoolerMiser, reduce the energy consumption of a snack or vending machine up to 40% by deactivating non-essential functions while not in use (Tufts University, 2001). This allows the machines to retain any thermal properties needed to keep products fresh, but reduces power consumption by approximately half. The current generation of vending machines (EPA, 2012) are coming from the factory with energy saving mechanisms, but cost between \$3,000-\$4,000 per unit. These devices are inexpensive, backwards compatible with our older vending machines, and have a rapid return on investment through accrued savings. Furthermore, the appliances are capable of diminishing the university's energy consumption, ultimately furthering Southwestern's commitment to sustainability.

METHODS

For the improvement of Walzel gym, our group asked for \$10,000 from the Green Fund grant to cover the initial cost of purchasing and installing 30 new LED bulbs and fixtures, and the full amount was granted on April 21, 2016 by the Sustainability Committee. This money will act as the initial investment in a “turnkey-loan” with the contractors, which will replace high interest conventional loans with one that will have no further up front cost. Choosing this type of loan will allow the contractors to provide all of the required lights for 25% of the total price, and the university will then reimburse them with the money aggregated from energy savings until the balance for the lights and installation is paid in full. Southwestern will see immediate savings after converting Walzel’s high energy consumption bulbs to LED fixtures, as powering LEDs requires around 50% less energy and they do not need to be replaced as often as the incandescent bulbs that Walzel currently employs (Schwartz, 2016). The current incandescent bulbs produce a considerable amount of heat while in use, requiring the school to rely heavily on the building's cooling system . This is a superfluous cost that can be significantly ameliorated by switching to LED alternatives. The savings from all of the listed benefits will be used to pay off the lights in an estimated 2-3 years at no upfront, out-of-pocket expense to the university and with no inflation in monthly payments for energy.

A critical component of this project has been consistent, straightforward communication with many individuals across various departments. Over the past few weeks, meetings have taken place with the athletics directors in the Robertson center and with members of Physical Plant in order to solicit their support and expert opinions. Their interest was a crucial component of gaining approval for the project, and open lines of communication and deliberation regarding costs and feasibility of the project were vital to its success. We obtained written approval and support from William “Shorty” Schwartz (Manager of Facilities & Maintenance Operations), Dr. Glada Munt (the Director of Intercollegiate Athletics at Southwestern University), Glenn Schwab (Assoc. Athletic Director/Director of Athletic Training Services) and Craig Erwin (Vice President for Finance and Administration). All of these individuals were instrumental in bringing together a comprehensive and feasible presentation to the Sustainability Committee for financial support in the form of the Green Fund. It is highly recommended that future projects regarding infrastructure and sustainability at Southwestern should should procure similar support

from these departments.

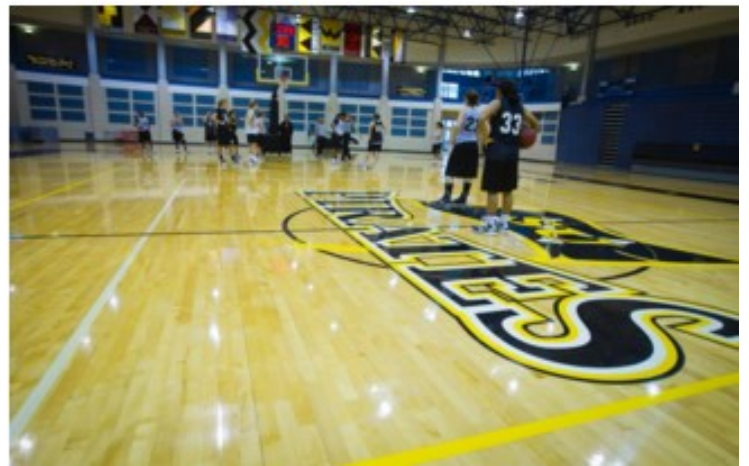
As a result of maintaining these open lines of communication, a sample LED light from Holophane, a University endorsed vendor, was installed on April 8, 2016. This allowed for a visual representation in the difference in light quality for those unfamiliar with the Walzel lighting array (Figure 1). A prospective bid for the project was received from ELS-Spectrum, a contractor who can source and install the lights themselves, as well as recycle the old HID lights. Negotiations with lighting contractors and distributors such as Grainger, who can supply lights from competing manufacturers, and Ringdale, a local company in Georgetown, resulted in a variety of bids and lighting options. Pending the approval of a specific contractor and lighting combination, the installation of the lighting system with the chosen contractor can be scheduled and the project can enter its final stages.



Figure 1: The current HID lights in Walzel Gym compared to the LED sample light installed this semester (in the middle). HID output is approximately 45 foot candles, LED is approximately 65 (LED model: Holophane Vantage).

PROJECT CONSIDERATIONS

The Walzel gymnasium is one of the most highly trafficked gyms in the Robertson facility. This gym is used for intramural sporting events, fitness education classes, athletic practice and for numerous organization events. The upgraded lighting will make the Walzel gym more accessible and attractive to students, and will hopefully raise their interest in sustainability on the Southwestern University campus. Currently, student-athletes are under-represented participants in campus sustainability initiatives. By creating a more sustainable environment for these specific students, this project aims to expose all students (especially athletes) to ideas of environmental sustainability by demonstrating that greater efficiency can improve the quality of athletic space, and foster a deeper community-wide interest in environmental issues. These two concepts are fundamental to, and are outlined in, the Talloires Declaration adopted by Southwestern University to bolster environmental sustainability (Southwestern, 2007).



LED VS. HID LIGHTING

There are numerous benefits gained from switching from High Intensity Discharge (HID) to advanced LED lighting systems. The present 480 VAC HID fixtures emit an excess amount of heat while active which increases the ambient temperature in the gymnasium (Schwartz, 2016). Due to the nature of the facility and the amount of heat generated from the current lighting arrays, air conditioning units in Robertson Center must labor more frequently to compensate and to keep the room at the needed temperature. LED lights emit very little heat, and therefore will generate savings from a reduction in both cooling and energy costs within the Robertson Center by reducing the overall stress placed on the HVAC systems in the gymnasium.

In addition to the benefits mentioned above, the HID lights take nearly 20 minutes to warm up and be at full luminosity after activation. This requires the lights to be left on all day so that the gym is ready to be used as soon as someone arrives, further exacerbating the unintentional increased heating of the gym associated with the HID system. Alternatively, the proposed LED lighting system will turn on almost instantly, indicating that it can be activated or deactivated as needed and at a moment's notice. This transition to a new state-of-the-art LED lighting system will allow for a more responsive and efficient lighting system.

Another advantage of switching from HID to LED would be the longevity of the lights themselves. Commonly, HID lights last about 2,500 hours before they need to be replaced. However, an LED system can last nearly 65,000 hours before the drivers need to be replaced (Schwartz, 2016). LED bulbs experience a depreciation of 10% in produced illumination after 100,000 hours of usage, which will generate savings by not having to replace burnt out bulbs as consistently as with the HID system. Furthermore, as the HID bulbs depreciate over time, the glass transitions through different color shades, causing uneven lighting (Ibid.). Thus, the superior design of the LED lights provides a reduction in maintenance compared to the HID lighting. They require no cleaning and do not succumb to 'yellowing' with age commonly associated with HID lamps (Figure 2).



Figure 2: HID lighting systems are prone to “yellowing” after prolonged use while LED systems retain their clarity over time.

Overall, the proposed LED lighting in Walzel will have the following beneficial specifications: guaranteed long-term levels of luminosity, fade-resistant glass, durable construction, a 5 year warranty, and built-in surge protection. The result of all of these advantages will be a lighting-system that will provide clear, consistent lighting for significantly longer periods of time. Ultimately, the end result of this change to more efficient lighting is noticeable in a savings of both time and money, as well as providing superior overall ambience for those who utilize the Walzel gymnasium.

LIGHTING SPECIFICATIONS

Current Lighting Setup:

- 480 VAC HID (high-intensity discharge) fixtures with an output of 423W per fixture
- Each fixture has an expected life of 10,000 hours (roughly 1 year)



Figure 3: The current HID lights in Walzel Gym.

Proposed Lighting Setup:

- 230W LED fixtures
- Ambient light temperature of 149 °F
- 80fc (footcandles) for varsity games, 50-60fc for practice times
- Driver lifespan of 65,000 hours
- Fixture lifespan of 100,000 hours
- 5 year warranty



Figure 4: The LED sample light from Holophane installed this semester.

ENERGYMISER

Vending machines are shown to be a passive energy drain on infrastructural energy. When not in use, the devices remain active, often well lit, and in a constant state of unnecessary refrigeration. This problem has become highly visible, and the National Wildlife Federation recently published an article detailing the redesign of outdated vending machines to incorporate technology that renders them more energy efficient in the future (EPA, 2012). These new updates to a vending machine, however, can cost upwards of \$3,000, making the return on investment on multiple machines a factor that may take a decade to occur. To mitigate these impacts, we have adopted a secondary initiative to outfit vending machines at Southwestern University with EnergyMiser products, both as a backup if our primary objectives are not met, and as a measure to identify and reduce potential waste within the university infrastructure.



In order to reduce the cost of vending machine operation, our group turned to the company known as EnergyMiser. Currently, EnergyMiser offers 2 products to help reduce the cost of operating vending machines, the SnackMiser vending machine device (\$155/unit) and the CoolerMiser soda machine device (\$165/unit). These 2 products cut costs by reducing the energy consumption while the machines are idle, thus reducing the buyer's carbon footprint and also saving them money. When installed, these devices reduce the annual energy requirement of each machine by roughly 46%, ultimately reducing the cost of operation by an average of \$150 per machine / year (EnergyMisers). In an impact study at Tufts University, the University found that their vending machines consume on average 3,468 kWh per year, costing them approximately \$381 per machine / year. After installing EnergyMiser products on these machines, Tufts found that each machine consumed only 1,716 kWh, ultimately cutting the cost of operation down to \$189 / year (Tufts Climate Initiative, 2010). Based on this study and information provided by EnergyMiser, each device can be expected to pay for itself in 1 year or less. Additionally, each device will also prevent 2,200 pounds

of carbon emission per machine, per year (Ibid.).

On April 21, 2016, this project was granted \$350 to operate on a trial basis. The funding will be used to purchase 1 CoolerMiser and 1 SnackMiser which will be installed on 2 machines on campus, pending the written approval of John Ore and Taylor Kidd. After acquiring and installing these devices, energy consumption will be monitored by a paid lab assistant in the Environmental Studies department in order to verify that the devices perform as intended. The annual savings generated from these devices will be used to purchase more Snack / Cooler Misers for the remaining vending machines on campus. Based off of the experiences of Tufts University, this side-project has the potential to produce tangible benefits by preventing 66,000 pounds of carbon from entering the atmosphere, reducing energy demands by 29,040 kWh, and by saving Southwestern \$4,500 annually if all 30 vending machines at Southwestern are outfitted with EnergyMiser products.



In summation, these EnergyMiser products are low cost, immediate impact items that have an

established track record of diminishing the Carbon footprint of institutions and facilities. Simply put, these devices will be a testament to Southwestern's aggressive stance on reducing waste and increasing efficiency and sustainability, They are inexpensive and have a short return on investments, making them a compelling, efficient, low-risk / high-reward option for strengthening our university's sustainability efforts, as well as fitting into the university's overall strategic plan for energy, waste, and dining sustainability.



CURRENT EFFORTS AND THE FUTURE OF ROBERTSON

As mentioned previously as of April 21st, 2016, the proposed grant of \$10,000 from the Green Fund has been approved by the Sustainability Committee. With these funds, we are continuing our efforts to select a contractor from the existing pool of bids in order to move forward and complete the installation of the products. After selecting a contractor and installing the lights in Walzel, the accrued savings from this initiative will fund the remaining balance until it is completely paid. Once this

obligation is complete, the savings could easily be redirected to help update the lighting and other



Infrastructure enterprises throughout the rest of the Robertson Center.

In addition to Green Fund grants, this project considered a variety of other funding options to help finance the project, most notably, a fundraising campaign with university relations that would target past athletes, in the hopes that a renovation of a school gym would be appealing to this group of alumni. Along with a potential fundraiser, conceivable funding for the project came from the Athletics Department - a one time gift of up to \$3,000 which could be taken from their yearly budget. Lastly, during a meeting on April 22nd, alternative funding and/or consulting was discussed with the Texas PACE Authority and senior staff from Southwestern university. In the coming years, Texas PACE Authority has offered to fund a full campus energy audit conducted by a graduate level student intern free of charge.

Another important element in garnering support for the refurbishment of Robertson Center is the NCAA basketball tournament that will be taking place on the Robertson courts in the spring of 2017. In order to broadcast these games in HD, Robertson gymnasium must achieve a specific level of lighting quality according to NCAA safety and broadcast standards, which Robertson gym does not currently meet (National Collegiate Athletic Association, 2011). In order to accomplish this goal, Southwestern will have to correspond with contractors and go through an equivalent process to what this Capstone group is currently doing for the Walzel gymnasium in order to find a suitable replacement for the existing lights.

By investing in this project, Southwestern will conserve money by using student led efforts and see more immediate results than if the school were to begin this process later in the year with outside consultants. Furthermore, if the result of this project is proven to reduce the energy consumption of the building, as it is estimated to do, it could earn the university additional STARS points in the Building Energy Consumption category by the next audit in 2018, a category Southwestern has the opportunity to greatly improve upon. Future Capstone groups should ascertain if there are specific projects the school must undertake for sustainability initiatives, especially those that award STARS points, and encourage that those ventures be student led.



CONCLUSION

Despite the fact that Walzel gym is only a small portion of the much larger Robertson facility, the proposed lighting changes to this gym are expected to generate enough savings for future Capstone groups, environmental groups on campus such as H.E.A.T (Human Environmental Animal Team) or SEAK (Students for Environmental Activism and Knowledge), or the physical plant staff to have the capability to re-invest in other projects. This would ultimately cut the operational costs of the antiquated building, and serve as a template for future renovations. A re-investment of these savings into more lighting improvements throughout the Robertson Center (once the “turnkey loan” has been paid off) is the ultimate goal behind this project. The ongoing efforts to improve and update the infrastructure of Southwestern University is increasing in scope and momentum as a result of interdisciplinary efforts of students and faculty, who are committed to promoting sustainability while at the same time mitigating the environmental impacts of university infrastructure. These projects are a significant benefit to the Southwestern family of staff and alumni, along with the greater Georgetown, Texas community as a whole.

KEY PERSONNEL: SOUTHWESTERN ¹

Special thanks to all of the following personnel who assisted in providing excellent technical, analytical, and logistic support for these projects.

Craig Erwin: Vice President for Finance and Administration

- Department: Finance and Administration
- Instrumental in securing project authorization from Southwestern University
- Provided vital feedback regarding the feasibility of project financing efforts and cost benefit analysis
- Represented Finance and Administration at meetings
- Provided required project approval.
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Glada Munt: Director of Intercollegiate Athletics at Southwestern University

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¹This information is current as of April 29th, 2016

Paul Secord: Vice President for University Relations & Chief Marketing Officer

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- Facilitated media relations aspects of the projects
- Represented University Relations during meetings
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Glenn Schwab: Associate Athletic Director/Director of Athletic Training Services

- Department: Athletics
- Acted as representation for Athletic Services during discussion regarding lighting in the Walzel Gymnasium.
- Provided critical feedback as to the feasibility and timeline requirements of the installation process
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William “Shorty” Schwartz: Physical Plant Manager of Facilities & Maintenance Operations

- Department: Physical Plant
- Provided indispensable feedback throughout process on multitude of topics relating to physical plant, technical and mechanical systems and safety
- Provided detailed reasoning regarding feasibility and product knowledge
- Provided insight regarding the process of project authorization and management as related to Physical Plant
- Provided required project approval
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Thomas Williams: Supervisor of Mechanical Services

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Dave Wilmot: Pirate Card and Telecommunications Coordinator

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 - ⇒ 512-863-1600

KEY PERSONNEL: AFFILIATES ²

Michael Berens: Acuity Lighting

- Connected our team with the local lighting company, Ringdale
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Jonathan Blackburn: Managing Director Texas - PACE Authority

- Presentation PACE financing options to faculty heads
- Offered a free energy audit through a graduate student intern
- Will coordinate with Shorty to schedule a time in the summer for the audit
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John Campsmith: FSG Manager

- Contractor for turn-key install
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Gary Gant: Representative from Greybar

- Provided a bid from Greybar
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Brian Haas: Business Development Manager - Integrated Projects Group

- Acted as consultant for contracting and PACE related projects
- Met with project officials to discuss feasibility and costs related to improvements
- Worked with PACE to offer a free assessment of energy use on campus
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²This information is current as of April 29th, 2016

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GLOSSARY

- Foot-candles:** The unit used to measure illumination. One Foot-candle is equal to one lumen per square foot. It is an important measurement for the amount of light needed to safely use the gym.
- HID:** High Intensity Discharge lamps are electrical gas-discharge lamps which produce light with an electrical arc between tungsten electrodes. These lights are what are used in most gymnasiums, they are bright and durable, but also buzz, put off heat, and are not the most energy efficient option.
- HVAC:** Heating, Ventilating and Air Conditioning. These systems will benefit from the switch to LED lights, due to the drop in light temperature.
- LED:** Light-Emitting Diode emits light when electricity is applied. These lights do not rely on electrical arcs and thus can be more easily manipulated and controlled. They also do not put out a significant amount of heat.
- PACE:** The Texas PACE Authority is a nonprofit with the goal of making clean energy and Infrastructure projects more accessible. They do so with long term funding options that have no upfront cost to the institutions with whom they work.
- STARS:** The Sustainability Tracking, Assessment and Rating System is a self reporting framework for Colleges and Universities to track and measure their sustainability.
- Turnkey Loan:** A method of funding that involves paying off projects over time using only the savings from the project. This funding option is the only way we were able to raise enough money to fund this project.

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