**Project, goals, and desired outcome**
Temple Hoyne Buell Hall (TBH) was built in 1996 and is home to the Architecture, Landscape Architecture, and Urban Planning departments. The 73,000 square foot building was designed so that most classroom, studio, and office spaces have natural light available during the day. However, no automatic lighting controls were specified or installed in the building. This has two energy-wasting effects. First, many lights are on during the day when natural light would suffice. Secondly, many lights are left on during both day and night when spaces are unoccupied.

To encourage awareness of energy use among design students and faculty, and to reduce lighting and cooling energy use in the building, we will install occupancy, daylight sensors, and lighting timers in appropriate places within the building. All incandescent and fluorescent exit signs in the building will be replaced with LED exit signs. LED lights have very long life and significantly lower energy use, and are particularly suited to emergency lighting that must be on 24/7 or for lights that are located in difficult-to-maintain places.

Occupancy sensors turn lights off when no activity is detected in a space for a certain period of time. Daylight sensors turn lights off when natural light provides enough illumination for the normal function of that space.

By reducing lighting waste in classrooms, public areas, restrooms, and service spaces, electric use for lighting will be reduced by approximately 30% in the controlled areas. The energy required to cool the building in the summer will also be lowered slightly, by reducing the amount of waste heat generated by lighting. The total electric use in TBH has dramatically increased in the last three years, possibly due to increased plug loads or inefficiencies in the HVAC fan and pump systems. TBH now uses around 1.7 million kWh of electricity annually at a cost to the University of more than $130,000. The attached spreadsheet shows monthly and annual usage for the two electric meters tracking TBH usage.

Educational buildings in the U.S. use an average 20% of their electricity for lighting, and lighting retrofits and controls can save 30-50% of that lighting energy use. If lighting controls are implemented in TBH, an estimated 100,000 to 170,000 kWh annually could be saved. The value of those electric savings at university rates is around $7,500 - $12,700 annually.

**Improving campus sustainability**This project is aimed at waste reduction in the form of lighting energy. New buildings on campus must be designed to the LEED Gold certification standard, which requires lighting controls to be a part of the design. The remaining building stock on campus, however, must undergo lighting retrofits to bring them up to current standards. This project is a step toward that goal.

Beyond the simple energy savings of the retrofit, there is an equally valuable aspect of demonstrating an attention to energy use to the people using campus buildings. The built environment of our campus is a passive instructor to students about normal building operation. Our buildings should teach students that attention to energy use is important. Lighting controls are a part of that lesson.

**Project location and permissions**The project will be located entirely inside Temple Buell Hall, in the public spaces and the spaces where students spend the most time. Permissions to implement the project are provided by Assoc. Dean Gaines Hall, who is responsible for the Fine and Applied Arts department facilities and buildings.

**Affiliated departments, stakeholders**The educational aspects of this project will benefit students, faculty, and staff of three departments housed in TBH: Architecture, Landscape Architecture, and Urban Planning. As utility savings are currently still paid out of the University utilities account, the financial benefits of this project will accrue to the utilities account.

**Student involvement**

This project will be visible to students, faculty, and staff using the building. The quality of light in the public spaces will be improved during the day, without the glare of unnecessary electric lighting competing with the more pleasant quality of daylight. In the studio spaces where wall-mounted manual-on controls will be provided, plaques stating “Lighting controls provided using student environmental funding via the Student Sustainability Committee”, or other wording as approved by SSC marketing, will be attached to wall-mounted lighting controls. This will serve as advertising for the committee and the student fees, as well as an awareness builder when students turn on the lights.

Additionally, one or two student research assistants will take ownership of this project, to help manage the implementation of the project in concert with F&S – this will provide a valuable and in-depth educational experience in lighting and energy management for these students.

**Ongoing funding**

No ongoing funding will be required for this project.

**Sources of funding**

Two funding sources are proposed for the implementation of this project. $62,900 is requested from the Student Sustainability Committee to cover the daylighting controls and promotional wall plaques. The Revolving Loan Fund (RLF) will provided already-approved funding for occupancy sensors as well as LED exit signs, estimated at a cost of $32,000 for this building.

**Campus impact, iCAP goals**

Turning lights off is one of the simplest methods of energy reduction possible, and toward that end lighting controls should be implemented in all buildings on campus. The occupancy sensor project funded by the RLF is a major first step in controlling small spaces like bathrooms and classrooms. Large public spaces, like the atrium space in TBH, require solutions that are more complex and individualized, but this type of large-space projects work toward the same goal of overall campus energy use reduction.

**Greenhouse gas calculations**

100,000 to 170,000 annual kWh savings are estimated for this project, with an associated 167,200 – 284,240 lbs of CO2 emissions avoided annually. For scale, the annual per-capita emissions in the U.S. is around 38,000 lbs.

**Publicity and reporting**

Wall plaques will make students aware of the project whenever they turn on lights in the studio. Furthermore, information about the project will be sent out with the department e-newsletters to the students in the building, to raise awareness.

**Outreach goals**The publicity goal associated with lighting controls is to raise awareness with students, faculty, and staff that lighting can and should be used judiciously. A reminder of this whenever someone turns on the lights is a simple yet persistent way to transmit the message. Measurement of behavior change is somewhat difficult without separate metering of lighting, however observation of whole-building energy use can show the probable impact of controls and behavior change by users.

**Timeframe – start date and end date**

Lighting controls are relatively straightforward to install, however the locations for some of the sensors are high above the floor, and many are in classroom/studio spaces where installation schedules will need to avoid conflict with class time. The installation itself will require a few days of work by campus electricians. The specification and selection of the sensors and sensor location will require the input of the F&S lighting designer – the scheduling of the lighting designer’s time will require a number of months’ lead-time.

A preliminary design walk-through was performed with Eva Sweeney, F&S lighting engineer, to locate likely placements of sensors and control equipment. These preliminary design choices were used for the cost estimation portion of this proposal. If design decisions can be completed during the summer of 2013, installation could be scheduled early in the 2013 fall semester.

**Funding sources**

Two funding sources are proposed for the implementation of this project. $62,900 is requested from the Student Sustainability Committee to cover the daylighting controls. The Revolving Loan Fund (RLF) will provided already-approved funding for occupancy sensors as well as LED exit signs, estimated at a cost of $32,000 for this building.

**Anticipated budget**

This proposal uses budgeting installed-cost estimates for line items as follows:

Wall-mounted occupancy sensors: $250 each

Ceiling-mounted occupancy sensors: $1,000 each

Ceiling-mounted daylighting sensors: $2,000 each

LED exit signs: $100 each

Relay cabinets: $5,000 each (@$1,000/circuit)
Atrium daylighting sensor and installation: $5,000

**SSC funding items: Daylighting controls**

Daylighting controls will be implemented in the spaces with the highest potential for long hours of daylighting, which are the main atrium and curved hallways along the faculty offices, as well as the 9 large studios that line the east and north sides of the building on two floors.

Atrium
The atrium space lighting can all be controlled by a single daylighting sensor. The atrium lighting consists of the soffit can lights, the linear fluorescents lining the office hallway, the can lights over atrium stairs, and the wall sconces. The sensor will communicate with 5 new relay cabinets (1 per floor), located with the existing relay cabinets near the restrooms. The sensor itself will be installed in the suspended ceiling above the atrium, which is accessible from the top floor review room (Eagle’s Nest).

1. Main atrium and office walkways
	1. 1 daylighting sensor $ 5,000
	2. 5 relay cabinets $25,000
	3. Design $ 5,000
	4. Engineering $ 5,000
	5. Contingency $ 4,000

ATRIUM SUBTOTAL $44,000

Note: The cost of the relay cabinets may be less than this estimate, if upon engineering review there are fewer than 5 circuits per relay cabinet. A contingency is included here also as the atrium daylighting item requires engineering discovery of the existing electrical setup. If these estimates are high, any remaining funds will be returned to the SSC for realloaction.

Studio spaces
The studio spaces lighting will be controlled by a daylighting sensor/occupancy sensor combination. The lighting in each large studio space is currently divided down the middle on two switches. An occupancy sensor will be assigned for each side, with a daylighting sensor mounted in the center of the space. These will be programmed to function as follows:

Upon reaching adequate daylight levels, the lights will be turned off. Wall controls will allow for an over-ride of this, with a manual on/auto off setup. The auto-off will be controlled by the occupancy sensor for each side of the room, after a delay of 30 minutes.

1. 9 studios
	1. 9 daylighting sensors $18,000

STUDIO SUBTOTAL $18,000

Publicity

Wall plaques will be placed next to the wall-mounted manual on controls for the lights in the 9 studio spaces.

1. 18 wall plaques $900

PUBLICITY SUBTOTAL $ 900

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SSC FUNDING TOTAL $62,900

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**Revolving Loan Fund items: Occupancy sensors & LED exit signs**

LED exit signs and occupancy sensors will be implemented in appropriate spaces throughout the building.

1. Exit signs (30 signs) $ 3,000

 EXIT SIGNS SUBTOTAL $ 3,000

1. Wall-mounted occupancy sensors
	1. 5 review rooms $ 1,250
	2. 3 seminar rooms $ 750
	3. 4 classrooms $ 1,000
	4. 2 galleries $ 500
	5. 10 restrooms $ 2,500

WALL-MOUNT SUBTOTAL $ 6,000

1. Ceiling-mounted occupancy sensors
	1. Computer lab $ 1,000
	2. Auditorium (2 sensors) $ 2,000
	3. 2 labs $ 2,000
	4. 9 studios (18 sensors) $18,000

CEILING-MOUNT SUBTOTAL $23,000

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