

**SSL DEMONSTRATION:****Architectural and  
Theatrical Lighting  
at the University of  
Florida**

Four academic/performance-related spaces put LED lighting to the test.

The U.S. higher-education sector spends an estimated \$14 billion on energy each year, with 20–31% percent attributable to lighting. The University of Florida (UF), located in Gainesville, is one of the nation's largest universities, with 50,000 students. UF's 46,000-square-foot Nadine McGuire Theatre + Dance Pavilion houses several types of spaces related to the performing arts. Like most academic buildings, the hours of operation are long, with normal evening activity including classes, rehearsals, and performances. Lighting in such facilities requires flexibility—all types of performance arts are shared with an audience, and body movement and facial expression serve as important means of communication. Halogen theatrical instruments have been used to light performance spaces, with a draw of 575–2000 watts each. Many of these products are filtered using absorptive colored media, reducing the already-low efficacy (lumens per watt) of the emitted light.

UF and the U.S. Department of Energy (DOE) GATEWAY Demonstration program combined forces to investigate a switch to LED architectural and theatrical



The same dance was lit by halogen (left) and LED sidelighting; audiences reported a nearly identical look, with LED energy savings as high as 90%. *Photos by Stan Kaye.*

lighting in the McGuire Pavilion's Acting Studio and Dance Studio, plus the Dressing Room and the Scene Shop where theatrical sets are constructed.

**LED Design in the  
McGuire Pavilion**

Lighting around mirrors in the Dressing Room was switched from G25 incandescent lamps to LED A19 lamps with a high CRI (color rendering index), dimmable with a forward phase-cut box dimmer.

In the Scene Shop, existing T8 fluorescent luminaires were replaced with rows of 8' long LED linear luminaires spaced 6' on center, suspended 2' below the ceiling. The luminaires use LEDs indirectly mounted in the center spine, with the light directed upward into a white metal reflector that spreads the brightness over a large, diffuse surface, thereby reducing glare for Scene Shop users.

In the Acting Studio, relighting goals included improved switching and dimming control, along with better illuminance uniformity, brighter walls, and higher vertical illuminances for seeing faces, bodies, and gestures. As a result, 39W LED recessed downlights on 8' x 10' spacing and twelve 4' linear LED wallwashers were spaced 10' apart around the room perimeter at a distance of 5' from the wall.

The solution in the Dance Studio was an edge-lit, 4 x 5 pattern of GE Lumina-tion EL Series luminaires, each with an acrylic blade to diffuse light and therefore produce higher vertical illuminance for dancers, but with a minimal amount of glare. Since this room is converted into a dance performance space several times per year, LED theatrical instruments used for sidelighting effects were installed.

Dimming controls were added to the LED configurations in all four areas.

**Results**

Before and after energy monitoring was conducted on the converted circuits in the four areas so that power and energy savings could be documented. Students, instructors, and audience members completed questionnaires to provide feedback on the lighting and controls.

The Dressing Room after retrofitting with Cree 8.5W A19, 93 CRI, 2700K, 450-lumen LED lamps. These 40W incandescent equivalents produce almost twice the lumens of the 130V incandescent incumbent lamps.

*Photo by Stan Kaye.*

Based on the data collected, the average energy use in the Dressing Room was 40 kWh/week during the baseline period and 11 kWh/week during the retrofit period. The average net savings from the retrofit was the most dramatic seen in any of the spaces—at 29 kWh/week, or 72%. Changing to LED lamps also greatly reduced the amount of radiated heat, which was noted with relief by performers using this room.

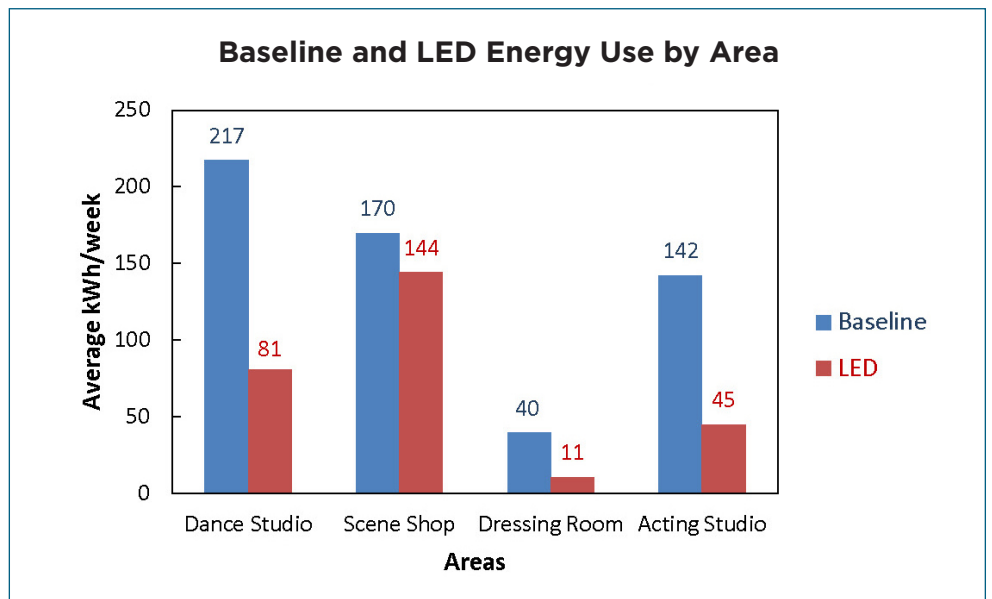
The Scene Shop’s fluorescent lighting included many burned-out lamps. As a result, savings from the switch to LED with a full complement of lamps totaled only 18%. Survey responses indicated that shadows decreased, which was perceived as important for student and instructor safety when working with power tools and machinery.

In the Acting Studio, the average net savings from the retrofit was 97 kWh/week, or 68%. Users greatly preferred the new lighting distribution, since evenly spaced luminaires, combined with wall lighting, helped improve the uniformity of light across the room.

In the Dance Studio, the average net savings from the retrofit was 136 kWh/week, or 63%. The light on faces and



The Dance Studio, after the general lighting was replaced with 20 edge-lit LED luminaires. *Photo by Stan Kaye.*



Summary of energy use (average kWh/week) in the four spaces before and after the change to LED lighting. Theatrical lighting energy use was not included.

bodies from overhead lighting was acceptable prior to the change, and the visibility of the dancers’ form, and their skin tones, seemed improved with the LED edge-lit luminaires. During performances, LED theatrical lighting employing colored gels saw an impressive 50–90% savings over halogen. Audience visual impressions of the halogen and LED sidelighting were almost identical.

All installed dimming controls resulted in energy savings and were embraced by users for improved functionality, especially in classrooms. In the Dressing Room, however, the dimmer created an audible buzz from the LED lamps at all output levels.

### Conclusions

The change to LED lighting brought significant quality improvements to the University of Florida School of Theatre and Dance. Chief among them was improved controllability, both switching

and dimming, compared to the original metal halide lighting systems located in the Acting Studio and Dance Studio.

Overall, the switch to LED lighting improved lighting quality in the four architectural spaces, due to a wise choice of products and luminaire light distributions. GATEWAY’s energy metering showed an average weekly savings of 418 kWh, or a total average savings of 73% in the four spaces.

Final reports on GATEWAY demonstration projects are available for download at [ssl.energy.gov/gatewaydemos\\_results.html](https://ssl.energy.gov/gatewaydemos_results.html).