Campus Lighting

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CAMPUS LIGHTING

LIGHTING EFFICIENCY OPTIONS FOR STUDENT RESIDENTIAL LIVING UNITS: A STUDY AT NORTHEASTERN UNIVERSITY, BOSTON, MASSACHUSETTS

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Halogen torchieres are one of the most popular types of lighting fixtures in the United States today, with an estimated 40 million units installed throughout the country. With an annual sales of 15 million fixtures at $20 each, sales reach 300 million dollars each year.

The typical torchiere fixture is a free-standing lamp with an inverted, bowl-shaped reflector and a high-intensity halogen bulb placed on the top of a pole.

The torchiere-style halogen fixture provides even, shadow-free lighting, an excellent type of illumination for reading and computer tasks. However, the popularity of these fixtures is of concern to insurers and energy analysts alike, given the significant energy inefficiency and the extreme fire hazard potential that can result from their high operating temperatures.

Fire safety and energy efficiency have also made halogen fixtures a concern for college and university administrators, residential life staff, campus safety officials and risk managers throughout the United States. A disturbing incidence of torchiere-related fires has been observed in student housing. And, the halogen fixture can account for as much as 50 percent of the energy consumption in student living quarters.

An alternative torchiere-style fixture, fitted with an energy-efficient compact fluorescent lamp (CFL), addresses both concerns and offers benefits in terms of insurance loss prevention and energy cost control.

This study involved the installation of highly efficient, compact-fluorescent torchiere replacement fixtures in a randomly selected group of student living quarters at Northeastern University. The purpose was to examine student acceptance of these fixtures as a replacement for the halogen torchiere and to quantify the energy savings that were achieved.

Three living units were selected as part of this study: a two-person men's unit, a two-person women's unit and a four-person apartment. Compact fluorescent torchiere fixtures utilizing two lamps, with dual-level switching, were installed in each unit. These fixtures were in place for approximately 45 days before the students were interviewed to ascertain their perceptions regarding the fixtures and the lighting provided.

The students reported high levels of acceptance of the amount of light provided. Each stated that the lighting was significantly better than what had been in place previously. There were some universal concerns about the sturdiness of the fixtures and also requests for more range of control, desiring continuous dimming rather than the two-level stepped dimming available in the installed fixtures. Fortunately, in the time that has transpired since the completion of this study, fixture manufactures have addressed each of these concerns.

Due to installation constraints, metering of energy usage proved impossible. Based on engineering calculations, the substitution of the standard 300-watt halogen torchiere with the 65-watt compact fluorescent torchieres resulted in average energy savings of about 80 percent. The calculated annual savings were approximately $42 per two-student room and $84 per four student apartment. The payback times ranged from six months to a year. The results confirmed that energy efficiency offers a pathway toward insurance loss prevention and significant energy cost savings.

INTRODUCTION

There are a range of instances in which energy-efficient technologies generate insurance loss-prevention benefits in addition to energy cost savings (Mills 1996; Mills et al 1997; Mills and Knoepfel 1997). A prominent case in point is the fire-safety improvement achieved by the replacement of halogen torchiere

fixtures with versions based on highly efficient compact fluorescent lamps (Page et al. 1997).

While insurance loss prevention is often a costly proposition, the case of the torchiere is an exception since the energy-saving (and fire-safe) alternatives actually pay for themselves many times over in terms of energy cost savings. In contrast, a $20 halogen torchiere can consume $100 worth of electricity each year.

The torchiere issue has recently come to the attention of the insurance industry, including property, life, health and product liability insurers. Fires caused by these fixtures result in property losses. For example, according to court documents, three of the largest fires caused losses totaling about $6 million and have led to litigation against manufacturers and retailers of the products. Furthermore, according to Ecos Consulting, there have been 350 torchiere-related fires accompanied by 114 injuries and 30 deaths. This fixture was also responsible for more than 100 fires in student living quarters during an 18-month period beginning in 1996. Canadian fire officials have cited torchieres as a source of fires in that country (Alberta Labour, 1997). Many torchiere-related fires have occurred at colleges and universities, thus our decision to engage in a demonstration project at Northeastern University in Boston, Mass.

TECHNOLOGY OPTIONS FOR RISK MANAGMENT

The lamps within the torchiere fixture operate at temperatures in the range of 700 to 1000 degrees Fahrenheit (Figure 1), well above the ignition temperature of most room furnishings. Consequently, many colleges and universities have banned the use of the halogen torchiere fixture, but have not provided alternative fixtures to meet the lighting needs of students. A central problem is that improperly specified replacement lighting systems can inadvertently compromise lighting quality, and thus the ability of students to study. This situation is clearly unacceptable in a setting primarily devoted to education.

In August 1997, the halogen fixture industry cooperated with the U.S. Consumer Product Safety Commission on a recall involving the distribution of wire baskets to keep flammable materials from contact with the bulbs in halogen torchieres. Even though these new guards have been sent out, consumers remain relatively unaware of them. Only 1.5 million are in use, while 40 million fixtures continue to burn without the new safety features.

This study was designed to examine the efficacy of a new lighting system using the compact fluorescent torchiere fixture, which complies with the ENERGY STAR® labeling program of the U.S. Environmental Protection Agency and Department of Energy. Additionally, we planned to explore the level of acceptance of these new fixtures by the students using them. Of particular interest were the energy savings achieved and the student perceptions regarding the quantity and quality of light provided. Issues such as aesthetics and the ability of the student to control the levels of illumination produced by the fixture were also examined.

The specific aim of this study was to replace 300-watt halogen torchiere fixtures with 65-watt compact fluorescent fixtures in student living quarters. The efficient fixtures were of the same style as the original torchiere and had comparable or superior light output and distribution properties (Figures 2 & 3). The maximum temperature of the CFLs is approximately 140 degrees Fahrenheit, a fraction of the 700 degrees Fahrenheit typically associated with 300-watt halogen fixtures. The lower temperature reduces the risk of igniting building furnishings.

DEMONSTRATION PROJECT

With the cooperation of the Residential Life administration of Northeastern University, three student rooms were selected for this study. Two of these rooms were occupied by freshmen students, with two male students in one of the rooms and two female students occupying the other. A two-bedroom apartment shared by four students was also included.

Each room was inspected, with particular attention given to the placement of existing lighting sources and to the potential placement of new CFL fixtures. Students were asked about their study habits, including where they normally did homework and where they did most of their reading tasks. Utilizing this data and other contextual information gathered from site visits, the number and location of the test fixtures for each space was determined (Figure 4).

The two freshman units received two fixtures each, while the two-bedroom apartment received seven fixtures: two for each bedroom, two for the living room and one for the dining area. Northeastern University had banned the use of the halogen torchiere already. An effort to meter these rooms individually proved impossible due to the location of the electric panels; energy savings were therefore estimated using engineering calculations.

RESULTS

All of the students involved in the study said they liked the quality and levels of illumination provided by the compact fluorescent torchiere fixtures. In the two-bedroom apartment, the students actually removed three of the new fixtures, citing their opinion that there was too much light with all the fixtures operating.

Students also expressed their desire for more control over illumination, indicating that a continuous dimmer switch was preferable to the two-step dimming switch available. The students also said that the fixture needed to be a little sturdier, as the units placed in their rooms tended to tip over rather easily.

The halogen fixture used a 300-watt lamp while the replacement CFL fixture used a total of 65 watts, including both lamps at 28 watts each and a total ballast loss of 9 watts. This provides approximately an 80 percent energy savings, with the dollar saving estimated at about $42 annually per freshman room and about $84 per year in the apartment unit. These assumptions are based on an average annual usage of about 970 hours per fixture and an electricity price of 9¢/kWh. The efficient fixtures typically cost about $70 retail, so the pay-back period ranges from about six months to a year.

All of the participating students indicated a desire to have the CFL fixtures designed to be wall-mounted, either as a sconce or some sort of indirect luminare. The main driver for this request is the lack of floor space typical in these residential units.

Figure 1
Thermograph comparing halogen (left) and compact fluorescent lamp (right) operating temperatures.

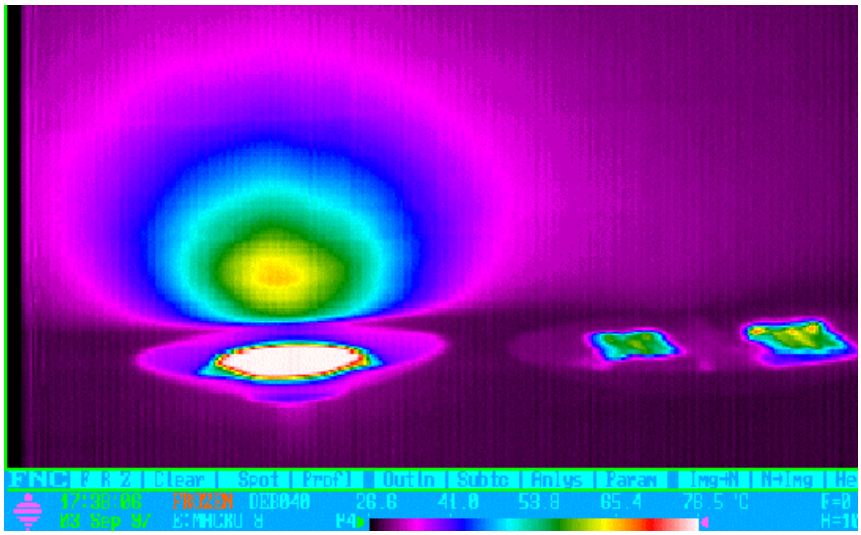

Figure 2
Illuminance diagrams show how the CFL fixture's light output (left) matches that of the halogen fixture (right).

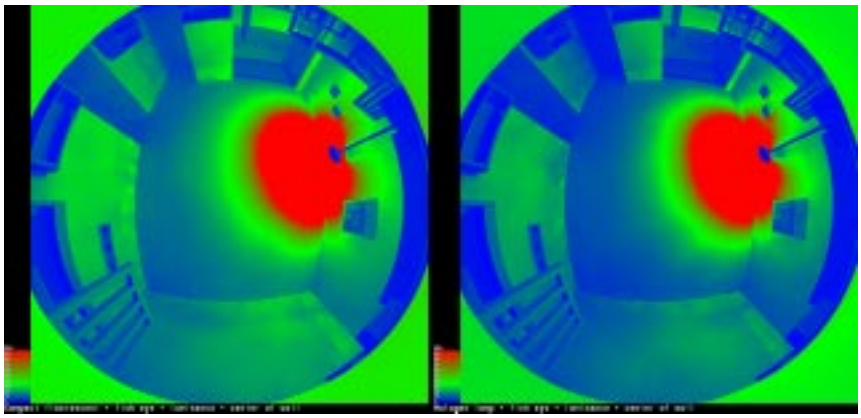

Figure 3
Candlepower distribution (light intensity) of a CFL torchiere vs. halogen torchiere.

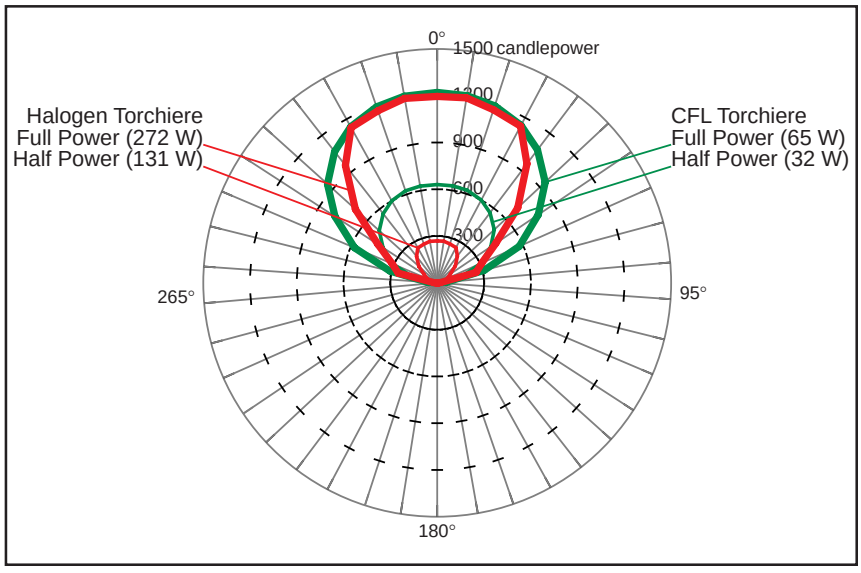

Figure 4
Typical first-year room after installation of the CFL torchieres.

CONCLUSIONS

The replacement of the halogen torchieres with CFL fixtures significantly reduces the possibility of fire-related insurance losses and also provides significant energy savings. Considering these benefits, we suggest that the compact fluorescent torchiere fixture become a permanent part of the lighting design approach in student living quarters at Northeastern University. The results should be applicable to other colleges and universities.

A number of initiatives are underway to transform markets so that halogen torchiere fixtures are replaced with efficient and safe compact fluorescent alternatives in universities and elsewhere (Calwell and Mills 1997). These activities – such as the new ENERGY STAR® fixture labeling program – involve government agencies, electric utilities and various non-governmental organizations. Insurers are beginning to participate, with good results.

REFERENCES

Alberta Labour, Fire Commissioner's Office. 1997. *Alberta Fire News*, May.

Calwell, C. and E. Mills. 1997. "Halogen Torchieres: A Look at Market Transformation in Progress*." Proceedings of the 4th European Conference on Energy-Efficient Lighting*, Copenhagen, Denmark. International Association for Energy Efficient Lighting.

Mills, E., A. Deering, E. Vine, March 1998. "Energy Efficiency: Proactive Strategies for Risk Managers," *Risk Management*, pp. 12-16, Risk and Insurance Management Society.

Mills, E. 1996. "Energy Efficiency: No-Regrets Climate Change Insurance for the Insurance Industry." *Journal of the Society of Insurance Research*, pp. 21-58, Vol. 9, No. 3. (Fall).

Mills, E. and I. Knoepfel. 1997. "Energy Efficiency Options for Insurance Loss Prevention." *Proceedings of the 1997 ECEEE Summer Study*, European Council for an Energy-Efficient Economy, Lawrence Berkeley National Laboratory Report No. 40426.

Page, E., E. Mills, and M. Siminovitch. 1997. "New Energy Efficient Torchieres Ready For Hot Torchiere Market." *Proceedings of Energy Efficiency in Household Appliances*, Florence, Italy. Published by the European Commission. Lawrence Berkeley National Laboratory Report No. 41176.

RESOURCES

More information about energy efficiency, safety and insurance loss prevention is available from the following sources:

Lawrence Berkeley National Laboratory
Attn: Evan Mills
MS 90-3058
Berkeley, California 94720
510-486-6784
emills@lbl.gov
http://eande.lbl.gov/CBS/Climate-Insurance/ci.html

Arkwright Mutual Insurance Co.
225 Wyman Street, P.O. Box 9198
Waltham, Massachusetts 02454-9198
1-888-ARKWRIGHT
http://www.arkrwright.com

The LiteSite—an on-line catalog of CFL torchiere products and related information:
http://www.lightsite.net/

ENERGY STAR® Residential Light Fixtures Program
U.S. EPA Atmospheric Pollution Prevention Division
401 M Street, SW (6202J)
Washington, D.C. 20460
Tel: 202-775-6650 Toll Free: 888-588-9920
Fax: 202-565-2134 Faxback: 202-564-9659
http://www.epa.gov/appdstar/fixtures/

International Association for Energy Efficient Lighting (IAEEL) List of Internet torchiere links
http://www.stem.se/iaeel/iaeel/lxr/hot.html

For more information and to calculate the energy savings from switching to a CFL torchiere, see:
http://eetd.lbl.gov/BTP/torchiere.html

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