Lighting Efficiency

HEALTHCARE - TOP 5 GREEN BUILDING STRATEGIES

EPA Publication 909-F-07-001

What? People intuitively prefer natural light to artificial light. Daylight and optimized artificial lighting can benefit hospital employees, patients and visitors. With rising energy costs and climate change concerns, using energy efficiently is financially prudent and expected. In addition, evidence suggests quantifiable benefits for staff retention, patient healing, and customer satisfaction.

Why?

Enhanced Community Reputation:

- Increases energy efficiency and reduced climate impact
- Improves building aesthetics
- Demonstrates environmental stewardship

Environmental/Staff/Patient Benefit:

- Improves indoor environment for staff, patients, and visitors
- Increases patient/staff satisfaction and comfort by providing more control of indoor environment

Cost Competitive:

- Improves facility's overall operational efficiency
- Potentially reduces staff error rates, increases staff retention, and hastens patient recovery

How?

- Use site selection and integrated building design
- Maximize available natural lighting
- Select lighting fixtures based on intended purpose
- Optimize energy use with sensors, timers, and control features
- Conduct audits to ensure continued effectiveness

Case Studies

- Emory University
- University of Florida

Green Guide for Health Care (GGHC) Criteria: *Construction: Energy & Atmosphere, Environmental Quality, Operations: Energy Efficiency* www.gghc.org

This is one of 5 ***Building Healthy Hospitals*** case studies developed by EPA's Pacific Southwest Regional Office, with Resource Conservation Challenge and Pollution Prevention funds.

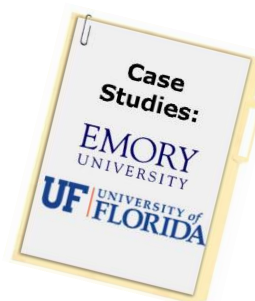
www.epa.gov/region09/waste/p2/projects/hospart.html

Indoor Air • Sustainable Flooring • Process Water Efficiency • Lighting Efficiency • Energy Efficiency

CASE STUDY: DECREASED LIGHTING POWER DENSITY, EFFICIENT FIXTURES, AND OCCUPANCY SENSORS

Applicability:	New construction, major renovation, or remodeling projects.
Environmental Impact:	▪ Winship Cancer Center: 31% savings in lighting energy ▪ University of Florida: Lighting energy consumption/savings not monitored
Other Benefits:	No other potential benefits such as worker satisfaction or productivity or patient outcome are monitored by either Emory or Univ. of Florida

Background



Improving lighting efficiency can be an inexpensive and effective way to achieve LEED Energy & Atmosphere credits. All of the case study facilities used strategies for maximizing natural lighting and minimizing artificial lighting. Emory implemented several strategies to improve lighting efficiency, including:

- **Incorporate Natural Lighting Features into Design.** Strategic building siting and orientation, skylights, large and strategically-placed windows, and locating high-use rooms in parts of the building with the most potential for natural light all can maximize daylighting.
- **Decreased lighting power density.** Lighting power density is expressed in watts per square foot for a given occupancy and individual space; maximum allowable lighting density is defined by ASHRAE 90.1. Energy use can be minimized by designing spaces that require a lighting power density less than the allowed maximum while still providing adequate light to meet occupant needs and visual comfort.
- **Efficient lighting fixtures.** Similar to varying efficiency of light bulbs, lighting fixtures are available with a variety of technologies that impact their overall efficiency. Fixture efficiency is simply the amount of light leaving a fixture compared to the amount of light generated by a given light source within the fixture. Energy use is directly impacted by the efficiency of fixtures installed throughout a facility.
- **Use of occupancy sensors.** Occupancy sensors control lighting based on the presences or absences of motion or heat. Occupancy sensors reduce energy use by automatically turning-off lighting when a space is unoccupied.

Performance

None of the case study facilities monitored lighting energy use separately from other energy use in their building. Based on energy use modeling conducted during the LEED certification process, and using the strategies above, Emory estimates its reduced energy consumption by 31 percent for compared to a similar facility (see Exhibit). Specific strategies Emory used at the Winship Cancer Institute are as follows:

- Emory decreased lighting densities throughout building from 1.6 watts per square foot (baseline case facility) to 1.1 watts per square foot. Emory University did not reduce the number of lighting fixtures installed through the facility.

- High-efficiency lighting fixtures were installed throughout the Winship Cancer Institute. Emory uses T-8s throughout campus; they do not use T-12s and have considered T-5s, but their electrical engineer does not believe the cost/benefit is sufficiently attractive; very few incandescent light bulbs are typically only used for dimming; compact fluorescents are use in can lights.
- Infrared occupancy sensors were installed to control lighting, in offices, laboratories and non-clinical spaces. The sensors detect both heat and motion and include a 15-minute timer with override controls. Emory University installed wall mounted sensors in offices and small occupied spaces and ceiling-mounted sensors in hallways, large classrooms and bathrooms. Emory estimates that the sensor alone can decrease lighting energy use 10 to 25 percent depending on the location.

Specific strategies used at the University of Florida Orthopedic Center:

- Installation of high-efficiency lighting fixtures, mainly fluorescents (CFLs and T-8 bulbs) throughout the facility along with a very limited number of other less efficient bulbs used for specialty tasks.
- Lutron brand occupancy sensors were installed throughout areas of the building with lower occupancy including patient rooms, hallways, and offices. The University of Florida building maintenance staff indicated the need for additional ongoing maintenance effort from adjustments required by building occupants. In addition to the initial adjustments made immediately after installation, staff turnover and equipment "calibration" required a sustained maintenance effort.

Cost

- Emory stated that the initial lighting cost for the Winship Cancer Center was less than 10 percent higher than other similar facilities with conventional lighting systems and that the estimated payback was less than 2 years.

- Generally, occupancy sensor costs depend on the type and function of the sensor and range from $20 to $100 each. Watts Stoper, Novatos, Lutron SensorSwitch are common brands offering occupancy sensors.

Case Study *Vitals*

The following summarize success criteria for implementing this project at other healthcare facilities:

- Gather input from building occupants prior to designing artificial lighting systems, particularly when installing sensors in patient care areas and incorporate comments into implementation.
- Educate building occupants about the lighting efficiency features of the building to gain acceptance and reduce maintenance/adjustment. Consider using stickers, signs, and regularly updated energy consumption reporting to inform and encourage continued support and compliance.
- Track and record any labor savings associated with less frequent lamp changeout (e.g., from longer lasting fluorescent and LED lamps) to help justify initial cost premiums of high efficiency equipment.
- The sensitivity of occupancy sensors should be appropriate for room size and relative occupancy. There are two primary sensing technologies: passive infrared and ultrasonic that are suited to different applications (see the following description for further explanation: http://www.lutron.com/products/OccSensors.aspx?pid=PIRUSDT&cid=0

USGBC LEED CALCULATOR 2.0 – EMORY WINSHIP CANCER CENTER

EA4 Results.xls

EA Prerequisite 2 / EA Credit 1 / EA Credit 2

ECB Table

Energy Summary by End Use

End Use	Energy Type	Proposed Building Energy [10^3 Btu/h]	Budget Building Energy [10^3 Btu/h]	Optimized Energy Performance [%]
Lighting - Conditioned	Electricity	2,866,353	4,131,598	69%
Space Heating	Gas	57,527,451	57,062,680	101%
Space Heating	Electricity	786,875	760,924	103%
Space Cooling	Electricity	6,897,085	11,921,538	58%
Pumps	Electricity	1,059,853	1,758,030	60%
Tower	Electricity	1,528,590	2,914,732	52%
Fans	Electricity	6,270,260	6,270,260	100%
Service Water Heating	Gas	204,111	204,111	100%
Equipment	Electricity	2,844,042	2,844,042	100%
	TOTAL BUILDING CONSUMPTION	**79,984,619.1**	**87,867,913.2**	**91%**

Energy and Cost Summary by Fuel Type

Type	DEC' Use [10^3 Btu/hr]	DEC' Cost [$]	ECB' Use [10^3 Btu/hr]	ECB' Cost [$]	DEC' / ECB' Energy %	DEC' / ECB' Cost %
Electricity	22,253,057	$ 326,106	30,601,123	$ 448,441	73%	73%
Natural Gas	57,731,562	$ 279,812	57,266,791	$ 277,559	101%	101%
Process Energy*	(2,844,042)	$ (41,677)	(2,844,042)	$ (41,677)	100%	100%
Total Nonrenewable	77,140,577	564,241	85,023,871	684,323		
Renewable					-	-
Total including Renewable	154,281,154	$ 564,241	170,047,743	$ 684,323		

Percent Savings = (ECB' $ -DEC' $)/ECB' $ = 17.55%

* Cost calculated using virtual rate ($/kWh) computed by VisualDOE