

## SCHOOL LIGHTING

There is significant potential for lighting system changes and dollar savings in most schools. These changes can save energy (and associated costs) and still provide occupants with the quality and quantity of light that is needed to perform their various tasks. Sources say that typically first investments should be made in the lighting system and ventilation system controls of schools. If you want to look for ways to save energy in buildings look long and hard at the **LIGHTS**.



A lighting system is just that - a system. It is important to consider the impact of the different elements on the whole. Its many elements are interrelated just as the lighting system itself is interrelated with other systems in the building. While energy can be conserved by properly removing lamps (light bulbs) and light fixtures, such action should be taken only after the impacts on the complete system have been considered to be sure the changes will not cause a problem. While conservation of energy is important it must be achieved without the loss of safety, productivity, visual comfort, aesthetics and compliance with federal, state, and local laws and ordinances.

An excellent initial step to save money through more efficient lighting is to reduce lighting levels consistent with the current use of the different spaces as identified during the building audit. In other words, how is the area being used and how much light is needed in the space for that use?

**Controls:** Turn off lights when not needed

Plan a program to turn lights on only when and where they are needed. The major advantages of such programs are that they can be tailored to the characteristics of the space, adjusted to the needs of its occupants, and implemented relatively inexpensively and quickly. The key element of a lighting use program is a lighting schedule related to occupant usage patterns. Personnel should be assigned, trained and made responsible for the efficient use of lighting according to the needs in the area. A light that is turned on is like a meter running in a taxi-cab.



## Appropriate Lighting Levels:

Areas can have too little light and they can have too much light. In the latter case, they are "over-lamped". Below are recommended lighting levels in the Handbook of the Illumination Engineering Society. The following table presents specific values pertaining to schools from the IES Lighting Handbook. With a light meter, it is relatively easy to determine, the lighting level by area.

### Special Areas: Schools

ENVIRONMENT WHERE TASK IS DONE	TASK DONE	Foot-candles Recommended
ANY SPACE WHERE:	Reading printed material	30
	Reading pencil writing	70
	Drafting, benchwork	100
	Lip reading, chalkboards, sewing	150
CLASSROOMS		
	Art rooms	70
	Drafting rooms	100
	Sewing room	150
	Cooking room	50
	Note-taking	70
LABORATORIES	Dissection, experiments, etc.	100
LECTURE ROOMS		
	Audience area	70
	Demonstration area	150
MUSIC ROOMS		
	Simple scores	30
	Advanced scores	70
SHOPS	Operate machinery	100
STUDY HALLS/LIBRARY	Study/typing	70

Source: Illumination Engineering Society, [IES Lighting Handbook](#).



## Bulb Types:

As you have already learned, traditional incandescent lighting is being replaced with CFL bulbs. It is said that LED light bulbs will eventually be what we use to replace incandescent bulbs – CFLs are a temporary solution to energy-efficient lighting. The reason LEDs have not yet displaced CFLs from the market are twofold: the first generation LED bulbs had a narrow and focused light beam, and the cost of the LED bulbs is still high. Study the comparison chart below taken from [www.eartheasy.com](http://www.eartheasy.com).

**Cost Comparison between LEDs, CFLs and Incandescent light bulbs**

	LED	CFL	Incandescent
Light bulb projected lifespan	50,000 hours	10,000 hours	1,200 hours
Watts per bulb (equiv. 60 watts)	6	14	60
Cost per bulb	\$35.95	\$3.95	\$1.25
KWh of electricity used over 50,000 hours	300	700	3000
Cost of electricity (@ 0.20per KWh)	\$60	\$140	\$600
Bulbs needed for 50k hours of use	1	5	42
Equivalent 50k hours bulb expense	\$35.95	\$19.75	\$52.50
<b>Total cost for 50k hours</b>	<b>\$95.95</b>	<b>\$159.75</b>	<b>\$652.50</b>

**Energy Savings over 50,000 hours, assuming 25 bulbs per household:**

<b>Total cost for 30 bulbs</b>	<b>\$2398.75</b>	<b>\$3993.75</b>	<b>\$16,312.50</b>
<b>Savings to household by switching from incandescents</b>	<b>\$13,913.75</b>	<b>\$12,318.75</b>	<b>0</b>

### Notes:

- Cost of electricity will vary. The figures used above are for comparison only, and are not exact.
- The cost per bulb for LEDs may vary. We used the figure of \$35.95 (for a 6 watt LED) as an average among lighting retailers. Eartheasy's retail price for a 7 watt LED is \$39.95.
- Estimates of bulb lifespan are projected, since it would take about 6 years of continuous lighting to test. Some manufacturers claim the new LED bulbs will last up to 25 years under normal household use, but this is not proven.
- Bulb breakage and bulb replacement costs have not been factored into this comparison chart. Incandescent bulbs and CFL bulbs are more easily broken than LEDs, which increases their cost of use.
  - Most LEDs come with a minimum 2-year guarantee. Any defective LED bulb will usually fail within this time.



Beyond the energy costs associated with selection of equipment such as lighting, there are also maintenance costs. For example, if you use incandescent lamps in your home with an average of 1,000 hours (*yes, the chart says 1,200 but we are making it easy here*) you will replace ten bulbs for every compact fluorescent lamp (CFL) bulb. If the change takes as little as six minutes you will have invested an hour of labor in "bulb changing". This idea also applies to building equipment. Although your team will be concerned primarily with the energy costs associated with your school you may want to consider the labor hours that are saved by recommending equipment, especially lighting, that has longer life spans and therefore do not need to be changed out as often.

## Lighting Inventory Survey:

You will notice that the amount of energy used to produce lighting depends on:

- 1) **The type of device used to produce the light (incandescent vs. fluorescent),**
- 2) **The amount of light produced,**
- 3) **Conditions in the space such as the color of walls, if any, and,**
- 4) **The amount of time that lights are on.**

The lighting inventory survey is intended to provide information on these variables. Switching to a more efficient lamping system does not make much sense if the lights are then left on all the time, nor can it be economically justified if the lights are never used. In your lighting recommendations, consider whether it is more economical to switch to more efficient lights; add controls that switch lights off when not needed; or de-lamping areas where lighting is excessive.

Think about it



### Simple Electricity Tips

#### **Use the lights less, when possible.**

- \* Turning off half the lights will reduce lighting emissions by 50%.
- \* Turning off one-third of the lights will reduce lighting emissions by 33%.
- \* Turn off lights when the classroom is empty - during lunch, planning periods, etc.
- \* Turn off lights at the end of the day.

#### **Slay energy vampires.**

Plug appliances into power strips, and turn the strips off at night. This will significantly reduce phantom loads.

#### **Flip the switch.**

Turn off computers and printers at the end of the day, rather than putting them in sleep mode.

#### **Common lighting recommendations of building energy auditors include the following:**

- \* Utilize fluorescent energy saver tubes and/or ballasts when replacement becomes necessary.
- \* Convert interior incandescent fixtures to energy efficient fluorescent lighting.
- \* Convert exterior incandescent fixtures to higher efficiency lower wattage lighting sources, such as metal halide, or high or low pressure sodium.
  - \*Consult a lighting specialist.
- \* Lighting may or may not provide for additional security after hours. People don't "hang out" in dark unlit places. Consider delamping and evaluating the change.



## BUILDING AUDIT CHALLENGE – LIGHTING INVENTORY SURVEY (STEP 4)

For the elementary school you are doing the energy audit for, do a lighting inventory and complete the ROOM LIGHTING SURVEY excel document. Ideally, a lighting survey should be done for every room of the building, and at various times of the day when the school is in operation. However, due to time constraints and logistics, you will do a lighting survey on a sample of rooms, then averaging and estimating the total at the end. You will also need to inventory the lights on the exterior of the building and in the parking lot. As well as determining the type of controls that is used to turn them on and off. Most of the room lights are operated by a wall switch; some of the outside lights may be on timers or photocells.

ALTERNATIVE ENERGY

### "INSERT SCHOOL NAME HERE" Room Lighting Survey

"Insert YEAR Here"

Information Compiled By:

"Students Names Listed Here"

Room #	Room Usage	Lighting Type			Measured Foot Candles	Switch Control Type	Comments: (windows, skylights, reflector conditions, etc.)
		Incandescent Bulbs #, wattage & type	Fluorescent Lamps #, Wattage, & Type, Including ballasts	High Intensity Discharge #, Wattage, & Type			
	Classroom						
	Classroom						
	Classroom						
	Classroom						
	Office						
	Library						
	Gym						
	Cafeteria						
	Hallway						
	Parking Lot						
	Exterior Face of Building						
	Building Sign						

1. Room usage: List primary activity such as Biology, office, art, music, conference, and home economics.
2. Bulb Count/ Watts: Identify the type & number of bulbs & wattage of each bulb. As appropriate, include ballast type & its wattage.
3. Measured Foot Candles: The reading obtained from the light meter at representative work locations.
4. Switch Control Type: How are the lights controlled? By a switch, are they on a timer, photovoltaic?
5. Comments: Does the room have windows, skylights? Are the reflectors dirty? Ceiling reflective? What color are the walls? At what height are the exterior lights mounted at?



### **Equipment and Information Needed:**

- 1) A floor plan of the school
- 2) A light meter that measures foot candles of illumination
- 3) Room Lighting Survey Sheet- (*Your group will need to determine a good sample of rooms to be measured*)
- 4) A camera and tape measure
- 5) A plan of attack



### **Outcome Required:**

- 1) Completed Room Lighting Survey Sheet coordinating with a
- 2) Diagramed floor plan, showing exactly where the inventory/ measurements were done in the building and
- 3) Exterior of Building Diagramed, where lights are located and their mounting heights.
- 4) A “Turn Off The Lights” Program that can be given and implemented by the elementary school teachers, students, and staff.