School LED Lighting

Best practices for selecting LED lighting for school and institutional facilities

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Experience is the best education.

The best practices and case study have been provided by **Harold Schock, energy and sustainability manager for School District #23 in British Columbia**. To determine the best TLEDs for retrofits, Schock and his team analyzed the light output and electricity consumption of LED lamps in various ballasts. The results from his analysis have become outdated with changes in LED technology, but his process and recommendations are just as relevant.

LED technology has a bright future. The potential for reducing energy consumption and electricity costs is tremendous, and improvements in LED technology are improving their efficiency at a rapid pace.

The main issue with LED technology – although an excellent indicator for its potential – is the difficulty to keep up with the technology. Product lists from LED suppliers are always being updated. Quotes for LED products this year will be substantially different from quotes for products next year. Performance of LED lamps is always improving, but their performance is directly related to the ballast they are installed in.

As a result, it is difficult to determine the most efficient and cost-effective LED technology for specific facilities. The best LED technology for one building may not be the best choice for another building. And the best products one year may be outperformed by newer technology the following year.

There are three main factors to consider when selecting LED technology:

1. **Manufacturer ratings**
2. **Existing lighting technology**
3. **Lighting needs in the facility**

An analysis of all three factors can assist in finding the technology that meets the lighting needs while minimizing electricity consumption and costs.

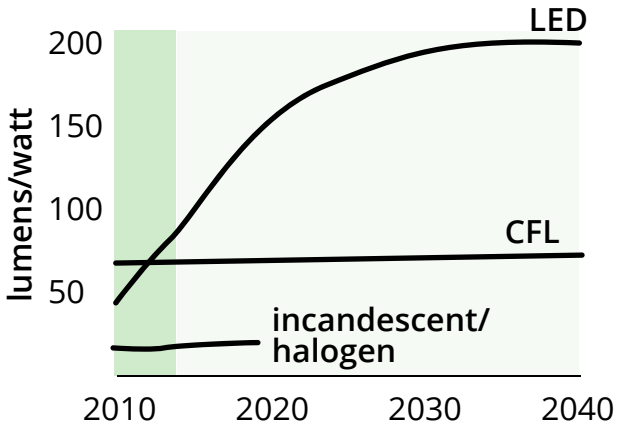
Nameplate numbers are only the start

Manufacturer ratings are one guide to compare LED products, but ratings don't consider actual performance in buildings. Nameplate ratings are most accurate when lamps are matched to ballasts by the same manufacturer, but this is not the case in many facilities.

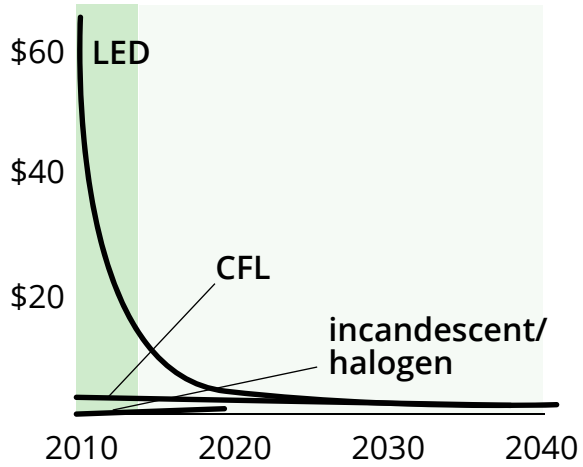
Retrofits are one scenario where expected performance may not match reality. Updating fluorescent lamps to TLEDs is a common retrofit but ballasts usually are outfitted with adapters and not completely changed. The unique lamp and ballast combination can change output, electricity usage and lifespan of all equipment.

Nameplate ratings are an excellent start, but a case-by-case analysis requires consideration for existing lighting technology and the lighting needs in the facility.

Past and projected lighting efficacy



Past and projected cost per bulb



Source: US Energy Information Administration, 2014

LED Technology

Nameplate ratings
Output and electricity usage for lighting products, as defined by the product's manufacturer.

Lumens
Amount of visible light emitted by a light source.

Lumen depreciation
Gradual reduction in the amount of visible light emitted by a light source. The lifetime of a LED lights is the amount of time a light's lumen output depreciates to 70% of initial output.

Foot-candles
Measure of light intensity commonly used to calculate lighting levels for buildings. Foot-candles can be measured using a light meter.

Watt
Rate of electricity consumed. Read more on our blog post: What is a watt? Watts can be measured with a multimeter.

LED lighting best practices

The goal for lighting is to sufficiently illuminate a space when required using the least amount of electricity.

Here are the best practices to minimize consumption while meeting the lighting needs.

Avoid over-illumination

Classrooms require excellent lighting, but there can be excessive lighting. Aim for 50 foot-candles in classrooms and consider light coming from windows.

Lamps perform best in their brand's ballasts

To achieve maximum efficiency, install LED lamps in their own brand's ballasts. Testing various combinations of LED lamps and other brands of ballasts can determine which combinations have optimal output with minimal electricity consumption.

Meet output with lowest wattage

Lowering the rate of electricity consumed with reduce consumption and utility costs. Even small reductions in wattage can result in significant savings over the lifespan of a lighting system.

Test and confirm

Nameplate information is a start, but the actual output and wattage may vary. Testing can provide information specific to your facilities and needs.

Look at all the numbers

Unit cost is only one factor. Also consider the wattage for lights that meet the needs for lighting without over-illuminating.

Lighting design guide for school facilities

Meeting lighting needs is necessary; exceeding lighting needs is a waste of electricity and LED technology. Match your lighting with your needs.

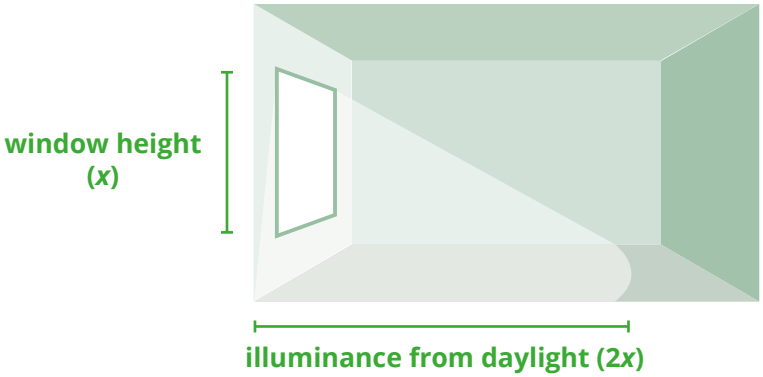
To measure existing lighting intensity, use a light meter to measure the foot-candles in every room. Measure the light in the darkest region of the room to ensure all areas meet the minimum standards. If need be, convert from foot-candles to lumens and watts with these ratios:

1 foot-candle = 10.76 lumens

1 lumen = 0.0015 watts

Foot-candles are measures in both horizontal and vertical illuminance. Horizontal illuminance is the light intensity on a horizontal surface, such as a desk. Vertical illuminance is the light intensity on a vertical surface, such as a wall.

Considering that light intensity fluctuates throughout the day as daylight fluctuates, lighting design recommendations provide a range in addition to the average. To account for daylight from windows, assume that natural light will sufficiently light the area that is twice the height of the window.



Here are the standards for illumination in school facilities in foot-candles, from the IES Lighting Handbook and ASHRAE 90.1 standards.

School Room	Average Maintained Horizontal Illuminance	Average Range Horizontal Illuminance
Classroom	40	30-50
Elementary gym	30 (100 vertical)	
High school gym	50 (150 vertical)	
Hallways	25	10-40
Auditorium	7.5	3-10
Restrooms	18	7.5-30
Offices	40	30-50
Break rooms	15	5-10
Libraries	30	
Labs	50	

Testing LED lighting options

With simple tools and a spreadsheet, Harold Schock saved his school district $10,000.

Schock the energy manager for School District #23 in British Columbia and was tasked with selecting LED bulbs for a lighting retrofit. To decide on the right LED lights for the building, Schock completed an in-house experiment that any facility manager can undertake.

Amprobe Light Meter

In his office, Schock set up a test bench with the same ballasts that were found in the school and a variety of TLEDs. He tested the wattages, light outputs and colour renderings from the TLEDs in the various ballasts with common tools. To measure power consumption, he used a Watts-Up Power Meter. And for light output, an Amprobe Light Meter. Schock was confident in his purchasing decision after a month of tests.

Watts-Up Power Meter

Schock recorded the data in a simple spreadsheet, where he was able to see that the TLEDs with the lowest unit costs were not the best choice. By selecting TLEDs with the lowest wattage, Schock estimates his district will save $10,000 over 20 years.

Results from Harold Schock's tests

		Phillips Ballast			GE Ballast			Standard Ballast		
LED	Rating	FC	Watts	kWhr/yr	FC	Watts	kWhr/yr	FC	Watts	kWhr/yr
Phillips P-12w	12 W	46	24	14739	46	27	16746	44	25	15617
Phillips GLASS	17 W	58	35	22015				43	34	21074
U Technology	15 W	61	36	22830	61	29	18377	51	36	22830
GE 3500K	18 W	69	43	26907	63	31	19380	59	40	25213
GE GLASS	15 W	58	38	24022	47	31	19569	50	35	22140
GE GLASS	12 W	49	32	19945	43	26	16182	43	29	18377
T8 28W GLASS	28 W	50	88	55194				50	88	55194

Annual costs at 1,600 hours of usage per year

LED	Annual Costs
Phillips P-12w	$1,444.44
Phillips GLASS	$2,157.44
U Technology	$2,237.35
GE 3500K	$1,899.29
GE GLASS	$1,917.73
GE GLASS	$1,585.81
T8 28W GLASS	$5,408.97