Bi-level Stairwell Lighting

"Bi-level lighting has a lot of energy savings potential. Over 60% energy savings and no complaints!"

–Paul Black, UC Berkeley Manager of Utilities Engineering

Energy Savings Opportunity

Stairwell lighting typically operates continuously at full output despite very low, intermittent use. A bi-level product line developed by LaMar Lighting uses an ultra-sonic motion sensor to detect motion in stairwells and corridors, and solid state controls are used to dim fixtures to lower light levels when a space is unoccupied. This product is ideal for areas where codes, user preferences, safety, or security requirements call for minimal light levels during unoccupied periods and full light output during occupied periods.

A preliminary study sponsored by the New York State Energy Research and Development Authority tested the technology and showed less than 4% occupancy of stairwells at two monitored sites with energy savings of 53% to 60% using bi-level fixtures that dim to 33% during unoccupied periods. Depending on the fixture configuration, the technology decreases light output from full output to 5%, 10% (120V only), or 33%. Thus, power in a typical two lamp 32 W T8 fixture is reduced from 64 W to 7–28 W.

Currently, most building codes require minimal lighting of 1 foot-candle (fc) for emergency egress in all staircases. However, a new ANSI standard has been proposed that would increase the required amount of light in stairwells during occupancy from the current standard of 1 fc to 10 fc on the stair tread or landing. To mitigate the increase in energy costs that would accompany such a requirement, these codes would also allow the use of bi-level lighting technology to reduce stairwell light levels back to 1 fc during unoccupied periods.

UC Berkeley Test Site

Researchers replaced 23 2-lamp 40 W T12 fixtures with 2-lamp 32 W T8 bi-level lighting fixtures in one stairwell at Evans Hall on the UC Berkeley campus, which is a 10-story math building with multiple stairwells. Lighting levels provided by the old fixtures ranged from 0.8 to 11 fc. Post-retrofit light levels ranged from 6 to 11 fc at 100% and around 1fc in standby mode.

Highlights

- 63% annual energy savings
- Three times the energy savings of a typical T8 retrofit
- 3.8 year payback
- Higher quality lighting

Product: Occu-smart® Series
Manufacturer: LaMar Lighting Inc.
Market: Stairwells, storerooms, restrooms, and laundry rooms
Site: Evans Hall, University of California Berkeley

Payback

The northeast stairwell of Evans Hall was retrofit with 23 2-lamp 32 W T8 Voyager bi-level fixtures for a total installed cost of $5,450. Extrapolating 4 months of monitored data for an entire year, the bi-level lighting retrofit results in annual savings of $1,430 per year compared to the old system, yielding a payback of less than 4 years (assuming $0.14/kWh).

In comparison, a standard lighting retrofit (i.e. typical 2-lamp 32 W T8 with no bi-level capabilities) would have a payback of 5.5 years, assuming $60 for a new fixture and $50 for installation.

Evans Hall Payback

	Energy Use (kWh/yr)	Energy Savings (kWh/yr)	Fixture Cost ($)	Installation Cost ($)	Total Cost ($)	Annual Cost ($)	Annual Savings ($)	**Evans Hall Payback (yrs)**
No retrofit	16,120	--	$0	$0	$0	$2,260	$0	**-**
Strandard retrofit	12,890	3,230	$1,380	$1,150	$2,530	$1,800	$460	**5.5**
Bi-level retrofit	5,910	10,210	$4,300	$1,150	$5,450	$830	$1,430	**3.8**

* Fixture costs were $187; installation time was approximately 30 minutes and estimated to cost $50.

For new construction, the predicted payback period is between 2 and 8 years depending on the fixture wattage of the alternative and the bi-level dimming capacity selected (5%, 10%, or 33%). Using a utility rate of $0.14/kWh, analysis shows:

New Construction Payback

Bi-Level Dimming Configuration	Standard Fixture Power (W)	Bi-level Fixture Power (W)	Bi-level Standby Power (W)	Estimated Time in Standby (%)	Average Bi-level Power (W)	Average Energy Saved (W)	Annual Energy Savings (kWh/yr)	Annual Cost Savings ($)	Added Cost Bi-level ($)	**New Payback (yrs)**
Dim to 5% at	62	62	13	95%	15.5	75	650	$91	$187	**2.1**
Standby	62	62	13	95%	15.5	47	410	$57	$187	**3.3**
(120V or 277V)	32	32	8	95%	9.2	23	200	$28	$187	**6.7**
Dim to 10% at	62	62	13	95%	15.5	75	650	$91	$172	**1.9**
Standby	62	62	13	95%	15.5	47	410	$57	$172	**3.0**
(120V only)	32	32	8	95%	9.2	23	200	$28	$172	**6.2**
Dim to 33% at	62	62	28	95%	29.7	60	530	$74	$163	**2.2**
Standby	62	62	28	95%	29.7	32	280	$39	$163	**4.2**
(120V or 277V)	32	32	14	95%	14.9	17	150	$21	$163	**7.8**

Study Results

Total energy savings for Evans Hall were calculated by recording the amount of time the fixtures were in standby mode (dimmed to 5%). Four months of data demonstrated that, on average, the fixtures were in the standby mode 68% of the time.

Figure 2 shows the average variation in bi-level lighting usage between floors. Usage patterns also differed from weekends to weekdays. Extrapolating four months of data to an entire year showed the bi-level fixture will save 10,210 kWh/yr, a 63% energy savings, or roughly **three times greater energy savings than a typical T8 lighting retrofit!** (**see Figure 3**)

In general, energy savings for bi-level fixtures depend on stairwell occupancy and the step-down settings. A comparison of energy savings at Evans Hall and three other California office buildings with similar bi-level retrofits show the greatest energy savings at Evans Hall (**see below table**).

The other three sites were in occupied mode less than 25% of the time but showed less than 50% energy savings. The sites used bi-level fixtures that dimmed to 33% compared to 5% at Evans Hall.

Bi-Level Fixture Energy Savings for Four Buildings

Building	Occupied (%)	Standby Mode (%)	**Energy Savings (%)**
Evans Hall	32%	68%	**63%**
Chiron Building M	25%	75%	**42%**
Alameda County Office	11%	89%	**46%**
SBC Office	18%	82%	**38%**

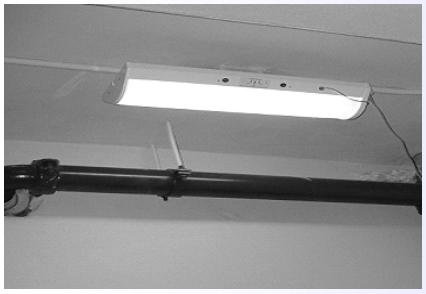


Figure 1- Example of the bi-level stairwell fixture.

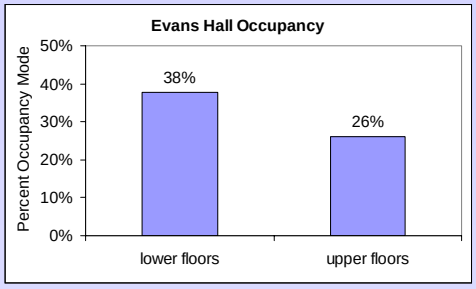
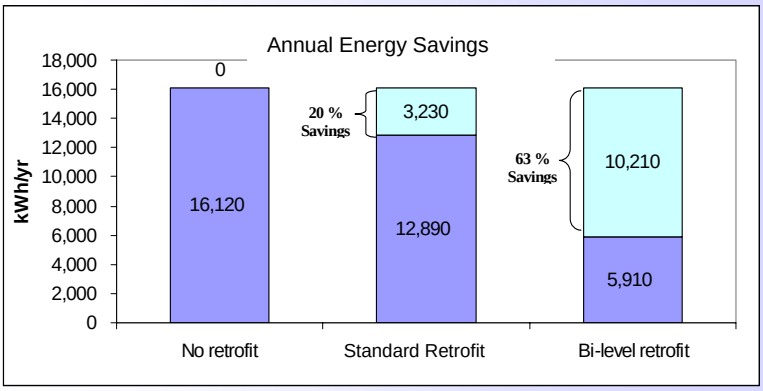


Figure 2-The percent time bi-level fixtures were in the occupied mode for upper and lower floors.



Energy Use Comparison Between Retrofits

	Percent Full	Percent Standby	Number of Fixtures	Watts Full (W)	Watts Standby (W)	Energy Use (kWh/yr)	Energy Savings (kWh/yr)	**Energy Savings (%)**
No Retrofit	100%	0%	23	80	n/a	16,120	--	**0%**
Standard Retrofit	100%	0%	23	64	n/a	12,890	3230	**20%**
Bi-level Retrofit	32%	68%	23	64	13	5,910	10210	**63%**

Figure 3- Shows the annual energy savings for the bi-level retrofit at Evans Hall compared to a standard T8 lighting retrofit. The table below the figure summarizes the data.

Conclusion

Using bi-level stairwell lighting clearly demonstrated a dramatic reduction in energy use at Evans Hall. Replacing old T12 fixtures with the bi-level fixtures resulted in 63% energy savings and a payback of less than 4 years. The fixtures were in the standby mode 68% of the time. The potential for energy savings is even higher in office buildings where stairwell usage is primarily limited to high traffic times. Bi-level stairwell fixture technology is designed to provide safe, reliable, and efficient lighting with high illumination during occupied periods and reduced illumination when stairwells are vacant.

Availability

The Occu-smart® Series bi-level light fixtures are currently being offered for sale through LaMar Lighting. To purchase or learn more about the system, visit the LaMar Lighting web site (www.lamarlighting.com).

About PIER

This project was conducted by the California Energy Commission's Public Interest Energy Research (PIER) program. PIER supports public-interest energy research and development that helps improve the quality of life in California by bringing environmentally safe, affordable, and reliable energy services and products to the marketplace.

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093005
Pub # CEC-500-2005-141-A26