



Integrated Classroom Lighting System

“Without hesitation, I would recommend this lighting system to other school districts!”

– Dr. Kelvin Lee, Superintendent Dry Creek School District

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Energy Savings Opportunity

Lighting typically represents 20% of the total energy use in a K-12 school. By reducing the connected lighting load and giving teachers more control of the lighting system, significant energy savings can be realized while providing a higher quality of light.

The Integrated Classroom Lighting System (ICLS) developed by Finelite combines a high performance direct-indirect light fixture with three high-efficiency Super T8 lamps. General-purpose classroom illumination (~0.95 W/sf) is achieved using 2 of the 3 lamps in the direct-indirect lighting fixture producing approximately 75 percent up-light and 25 percent down-light. An Audio/Video (A/V) or reading mode provides 3 percent up-light and 97 percent downlight using only a single down-light with optional dimming to 5 percent output. In the A/V mode, light levels on the ceiling and walls are reduced while an appropriate light level (~30 fc) is maintained on the student’s desk.

The ICLS delivers 25 percent more light per watt than standard T8 fixtures due to a new 96 percent reflective coating combined with Super T8 lamp and ballast technology. In addition, the ballast factor can be selected to keep the connected load to **less than one watt per square foot.**

Heritage Oaks School Test Site

Systems were installed in five classrooms at the Heritage Oaks School located in Roseville, California. This installation was one of 20 California sites, including a test classroom at Finelite and 14 additional classrooms at five other schools. Researchers tested for energy savings, occupant comfort, and overall system performance.

Four of the Heritage Oaks classrooms had retrofits with the ICLS lighting fixtures. Two of the classrooms had two rows of ICLS fixtures (one with A/V dimming, one without) with a 1.18 ballast factor. The other two classrooms had three rows of ICLS fixtures (with and without A/V dimming) using a 0.77 ballast factor. The control classroom retained the pre-retrofit lighting system, 26 two-lamp T8 recessed parabolic troffers.



The pre-retrofit classroom system is shown on the left with lensed troffers. The new ICLS system is shown on the right.

- Product:** Series 10 Integrated Classroom Lighting System (ICLS)
- Manufacturer:** Finelite Inc.
- Market:** Schools, conference and multi-purpose rooms found in commercial facilities, churches, and government buildings
- Site:** Heritage Oaks School

Payback

The cost of the classroom retrofits at Heritage Oaks was \$2600 for the two-row without dimming and approximately \$3100 with A/V dimming control. The third row of light fixtures cost an additional \$1100. The ICLS retrofit using occupancy sensors resulted in energy savings averaging more than 50%, which based on 7 months of data translate into nearly \$500 savings annually per room (\$0.14/kWh, 200 days per year). The resulting payback period was a minimum of 6.5 years for two rows of fixtures and a maximum of 9.6 years for three rows with A/V dimming control.

Heritage Oaks School Retrofit Payback Period						
	Average Daily Use (kWh)	Estimated Annual Use (kWh)	Estimated Annual Cost (\$)	Estimated Annual Savings (\$)	Initial Cost (\$)	Retrofit Payback (yrs)
Base Case (26 Parabolics)	26.6	5318	\$745	\$0	\$0	–
ICLS 2 Rows, No A/V Dim*	12.3	2469	\$346	\$399	\$2,600	6.5
ICLS 2 Rows, with A/V Dim*	11.4	2284	\$320	\$425	\$3,100	7.3
ICLS 3 Rows, No A/V Dim*	11.0	2191	\$307	\$438	\$3,700	8.4
ICLS 3 Rows, with A/V Dim*	10.9	2185	\$306	\$439	\$4,200	9.6

* Includes Occupancy Sensor

For new construction, the installed cost of the ICLS (~\$2.71 / sq ft) is less than the cost of a typical layout using 15 parabolic troffers (~\$2.86 / sq ft.). The maximum connected load for the ICLS is approximately 0.95 watts per square foot compared to 1.35 watts per square foot for more typical designs. The reduced lighting load combined with no additional first cost yields an instant payback! Installing the optional upgrade of A/V dimming still results in a payback of 2 years while a third row of fixtures has a longer payback (8.1 years), assuming \$0.14/kWh and 200 days/yr.

New Construction Estimated Payback Period						
Alternative	LPD (W/sq ft)	Installed Cost (\$/sq ft)	Installed Cost (\$)	Cost Difference (\$)	Cost Savings (\$/yr)	Simple Payback (yrs)
15 Parabolics (typical)	1.35	\$2.86	\$2,745	\$0	\$0	--
ICLS 2 Rows, No A/V Dim*	0.93	\$2.71	\$2,600	-\$145	\$106	Instant!
ICLS 2 Rows, with A/V Dim*	0.73	\$3.23	\$3,100	\$355	\$176	2.0
ICLS 3 Rows, No A/V Dim*	0.95	\$3.86	\$3,700	\$955	\$118	8.1
ICLS 3 Rows, with A/V Dim*	0.75	\$4.38	\$4,200	\$1,455	\$168	8.6

* Includes Occupancy Sensor

Study Results

Overall system performance was determined through energy usage data and an occupant comfort survey. Daily energy savings ranged from a minimum of 35% to a maximum of 75%, and averaged over 50% for the entire year for all four ICLS installations.

Most of the savings (~80%) were the result of the reduction in the connected lighting load from 1.8 to 1.0 W/sf. Additional savings (~20%) were the result of allowing teachers more control of the lighting system and providing occupancy sensors. The daily energy savings were clearly demonstrated for all four of the ICLS rooms (see Figure 1).

In the occupant surveys, teachers showed a preference for the three row ICLS over the two row. Increased lighting levels on all walls as well as on the teacher desktop were the most noted benefits of the three row system. Foot-candle measurements showed lower overall levels directly beneath the fixtures, 88 fc for three rows compared to 111 fc for two rows. Whereas, measurements showed increased illuminance near the walls, 30 fc for three rows compared to 22 fc for two rows. These light levels were achieved using the same W/sf in both cases by selecting lower ballast factors in the three row system.

The teacher comfort survey showed teacher preference for the ICLS compared to the typical lensed troffer lighting system (see Figure 2). The ICLS reduced glare and eye fatigue while increasing perceived light levels on all teaching surfaces. In addition, the teachers integrated the A/V downlight mode into their daily instruction with great success, switching lighting modes to change the learning environment.

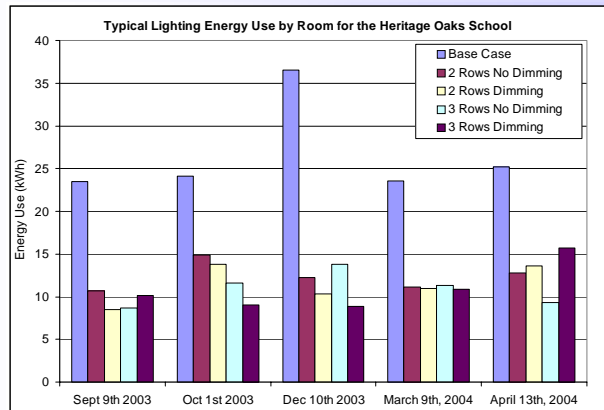
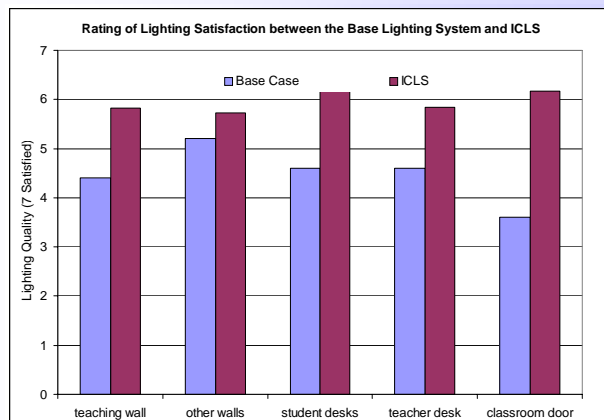


Figure 1 (above) -ICLS energy use compared to a lensed troffer lighting system. Energy savings vary seasonally. Greatest savings were realized during the winter.

Figure 2 (below) -Teacher satisfaction for a typical lensed troffer lighting system and the ICLS. The ICLS lighting increases satisfaction by providing a better distribution of light, and has a connected load of only 1.0 W/sf.



"The lights at first I felt were too dim, however over time I realized the previous ones were just too bright! These lights seem to be more natural and less harsh on the eyes."

-Heritage Oaks Teacher

Conclusion

The Integrated Classroom Lighting System test site at Heritage Oaks School demonstrated energy savings of more than 50% and teacher preference for the ICLS. The energy savings were realized by reducing the connected lighting load and giving teachers more control of the lighting system while providing a higher quality of light. The cost savings resulted in payback periods that ranged from 6.5 years to 9.6 years. In new construction applications, the ICLS provides greater energy savings, better control, and higher quality light to important surfaces for an installed cost less than a typical lensed troffer system.

Availability

The Series 10 Integrated Classroom Lighting System (ICLS) is currently being offered for sale through Finelite. To purchase or learn more about the system, visit the Finelite web site (www.finelite.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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