

# BREAKTHROUGH IN OFFICE LIGHTING FOR TODAY'S CHANGING OFFICES

Summary of the IOLS Research Findings

Terry Clark, CEO, Finelite, Inc.

The Breakthrough in Office Lighting explores how space planning and lighting design can come together to achieve:

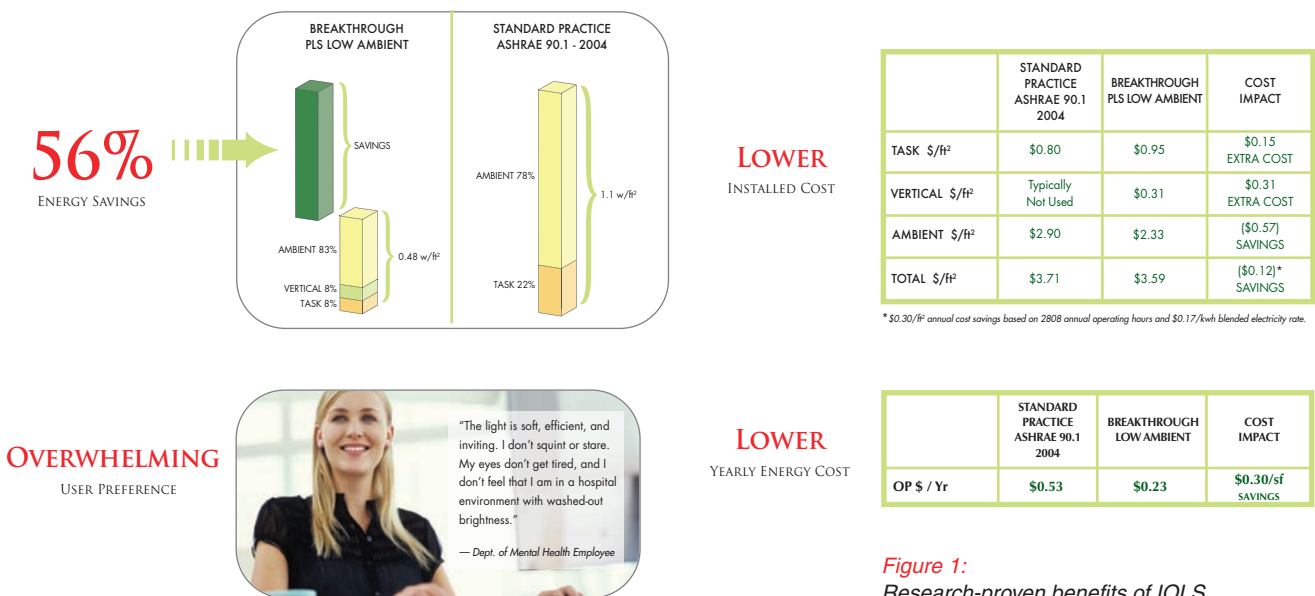


Figure 1:  
Research-proven benefits of IOLS.

Results are research-proven. Finelite, Inc. partnered with the California Lighting Technology Center (CLTC), and the California Energy Commission PIER (Public Interest Energy Research) Program to conduct a multi-year research effort to develop an Integrated Office Lighting System (IOLS). The research resulted in the invention of Finelite's PLS, an award-winning, patent-pending LED task lighting system designed to integrate with any type of office furniture. Because of the quality and distribution of light from PLS, it is possible to deliver over 50% lighting energy savings and overwhelming user satisfaction in offices at reduced cost. With a national inventory of 10 billion square feet of commercial office space, this 50% savings reduces electricity use by over 40 billion kWh and saves \$60 billion in avoided generation capacity costs.

The Breakthrough in Office Lighting has been able to achieve these results while also meeting or exceeding all standards of professional lighting practice. Case studies, feedback assessments, design templates, and budget parameters complete the action plan for implementation.

Goals of the Initial IOLS Research:

Beginning in 2006, the CLTC and Finelite partnered to study office lighting and set out to develop IOLS. The study quickly narrowed in on the concept of task / ambient lighting and identified why this design concept has not reached its potential for delivering greater energy savings. As it turns out, traditional fluorescent task lighting is the culprit. Developing an ideal task lighting system then became a major thrust of the research, with an overall objective of developing, demonstrating, and commercializing an office task / ambient lighting system that:

- Operates at 0.5 W/ft<sup>2</sup> of total connected load;
- Meets all professional practice design standards for lighting quality;
- Allows users to control their lighting;
- Makes the space beautiful to speed user acceptance;
- Keeps project costs down.

To accomplish these objectives, CLTC and Finelite:

- Determined that white light emitting diodes (LEDs) were the ideal technology solution for task lighting;
- Developed an initial prototype of the LED task lighting system by designing optics, electronics, fixtures, user interface, and power supply;
- Evaluated the prototype LED task lighting system performance in a laboratory environment including thermal analysis, luminance, and illuminance measurements;
- Conducted several field demonstrations of LED task / low ambient lighting systems utilizing the LED task lighting system and monitored performance, energy use, and user satisfaction;
- Commercialized the technology for widespread availability, produced by Finelite under the brand name Personal Lighting System (PLS).

Approaching LED task / low ambient lighting as a complete and integrated system is paramount to achieving low lighting power densities and user satisfaction. With this paradigm shift, the Breakthrough in Office Lighting results in:

- Lighting power density ranging between 0.50 and 0.65 Watts/sf for typical open office space, 45% 60% lower than CA Title 24 2008 and ASHRAE 90.1 2004;
- Tremendously improved user satisfaction through increases in lighting quality and flexibility to address individual user needs;
- Reduced installation, operating, and maintenance cost;
- More sustainable design resulting from using fewer lamps, ballasts, and luminaires.

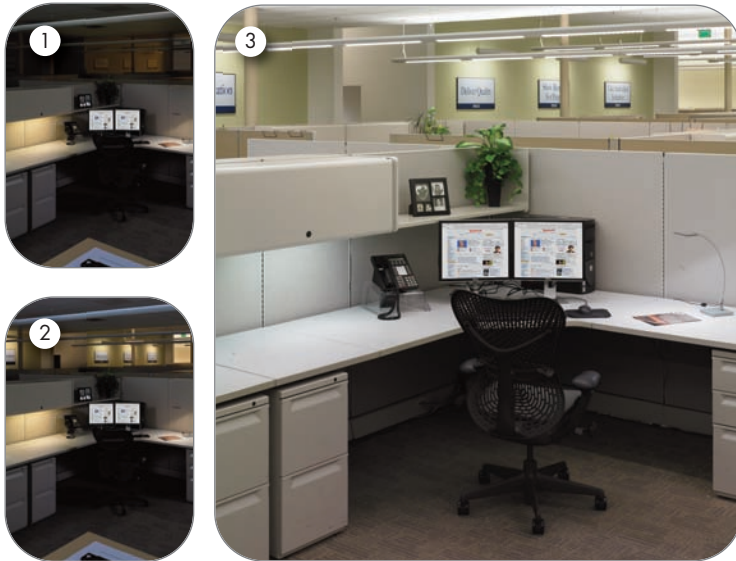
A simple design template works every time, and it relies on one premise - make task lighting the primary layer of light in offices. (Figure 2, 3, and 4.)

# ADDING THE LAYERS

## EASY AS 1, 2, 3!

**Figure 2:**

The IOLS template in a real space. When the task lighting does most of the work, the ambient lighting can be designed at 0.4 w/sf.



### 1 Light the task first

Just the PLS task lighting can virtually light the entire work area with only 12 watts.

### 2 Light the vertical surfaces

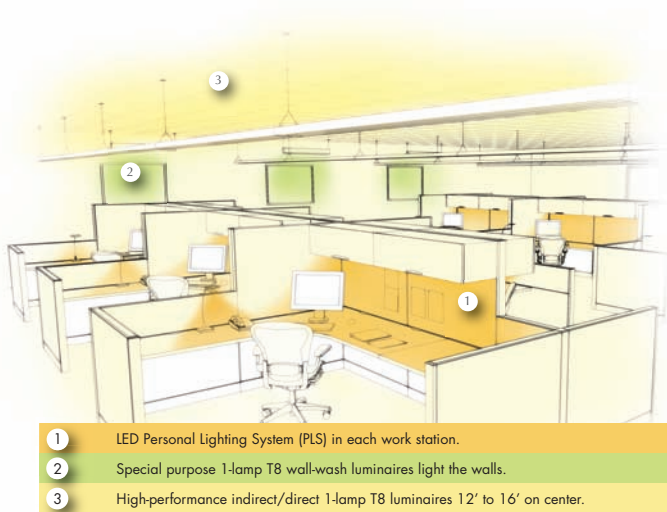
Adding a small amount of vertical illumination on the back wall begins to bring balance to the overall brightness in the space.

### 3 Fill in with ambient lighting at 0.4 w/ft<sup>2</sup>

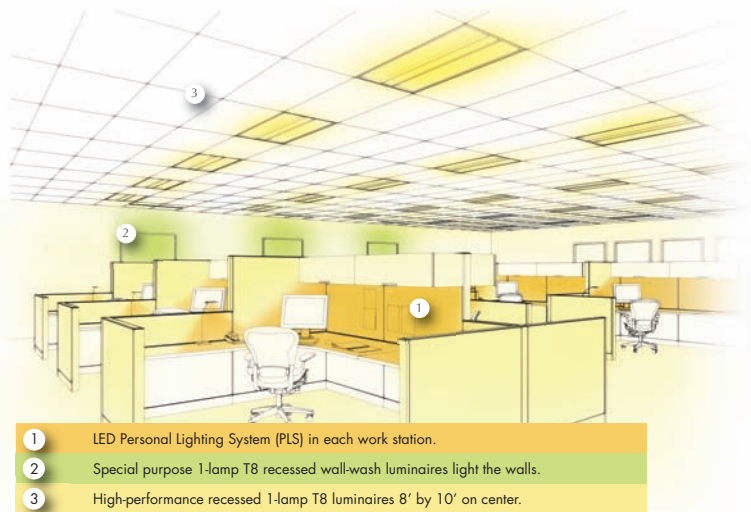
A low ambient approach creates a pleasant and inviting ambience. Illumination levels in the work areas meet task lighting requirements, while allowing for engaged personal interaction. Luminance ratios meet IESNA recommendations of no more than 3:1 in the immediate task area, and no more than 10:1 between the immediate task area and the surrounding visual field of view.

**Figure 3:**

With a high quality LED Task Lighting System, designers have the ability to choose the ambient lighting. The IOLS template still works.



- 1 LED Personal Lighting System (PLS) in each work station.
- 2 Special purpose 1-lamp T8 wall-wash luminaires light the walls.
- 3 High-performance indirect/direct 1-lamp T8 luminaires 12' to 16' on center.

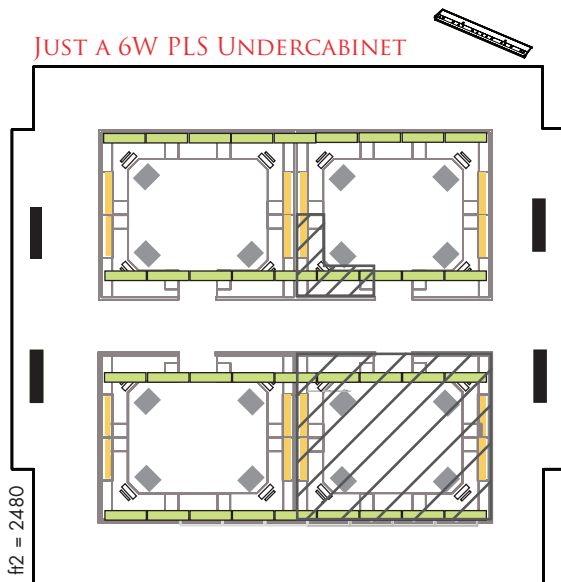


- 1 LED Personal Lighting System (PLS) in each work station.
- 2 Special purpose 1-lamp T8 recessed wall-wash luminaires light the walls.
- 3 High-performance recessed 1-lamp T8 luminaires 8' by 10' on center.

# BREAKTHROUGH IOLS

Figure 4:

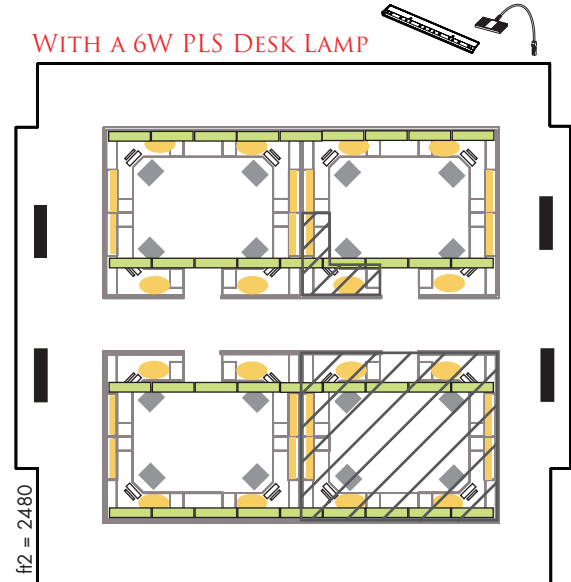
Cost and LPD details for IOLS designs. Energy, cost and CO2 emission savings are compared to ASHRAE 90.1 2004 standard practice.



JUST A 6W PLS UNDERCABINET

Breakthrough - PLS Low Ambient  
Average Maintained Illuminance:

= Workstation Area 30 fc avg.  
 = Desk Area 20-55 fc



WITH A 6W PLS DESK LAMP

Breakthrough - PLS Low Ambient  
Average Maintained Illuminance:

= Workstation Area 33 fc avg.  
 = Desk Area 20-70 fc

	DESIGN	COST / LPD
<b>TASK</b> 	(1) PLS 6w LED Undercabinet per workstation	\$0.95/ft <sup>2</sup> 0.04 w/ft <sup>2</sup>
<b>VERTICAL</b> 	(4) 4' 1-lamp T8 Wall Wash 3100 lumen 32w T8 lamp 0.71 BF	\$0.31/ft <sup>2</sup> 0.04 w/ft <sup>2</sup>
<b>AMBIENT</b> 	(4) 36' 1-lamp T8 ID Pendant (12' on center) 3100 lumen 32w T8 lamp 0.88 BF	\$2.33/ft <sup>2</sup> 0.40 w/ft <sup>2</sup>
<b>Total \$/ft<sup>2</sup></b>		<b>\$3.59/ft<sup>2</sup></b>
<b>Total w/ft<sup>2</sup></b>		<b>0.48 w/ft<sup>2</sup></b>

**56% INSTALLED ENERGY SAVINGS**

For every 100,000 square feet of office space, \$30,000 in energy costs and 240,000 lbs. of CO2 emissions will be saved every year.

	DESIGN	COST / LPD
<b>TASK</b>  	(1) PLS 6w LED Undercabinet and (1) PLS 6w Desk Lamp per workstation	\$1.79/ft <sup>2</sup> \$0.08 w/ft <sup>2</sup>
<b>VERTICAL</b> 	(4) 4' 1-lamp T8 Wall Wash 3100 lumen 32w T8 lamp 0.71 BF	\$0.31/ft <sup>2</sup> 0.04 w/ft <sup>2</sup>
<b>AMBIENT</b> 	(4) 36' 1-lamp T8 ID Pendant (12' on center) 3100 lumen 32w T8 lamp 0.88 BF	\$2.33/ft <sup>2</sup> 0.40 w/ft <sup>2</sup>
<b>Total \$/ft<sup>2</sup></b>		<b>\$4.43/ft<sup>2</sup></b>
<b>Total w/ft<sup>2</sup></b>		<b>0.52 w/ft<sup>2</sup></b>

**53% INSTALLED ENERGY SAVINGS**

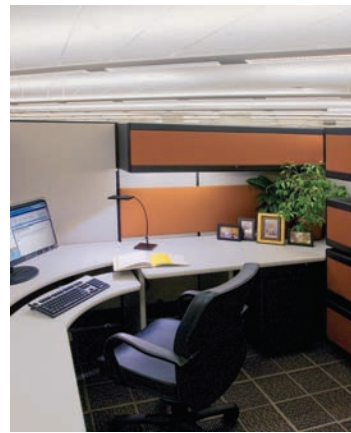
For every 100,000 square feet of office space, \$28,000 in energy costs and 220,000 lbs. of CO2 emissions will be saved every year.

# CASE STUDY:

## DEPARTMENT OF MOTOR VEHICLES, SACRAMENTO, CA



Pre-Retrofit Lighting



Post-Retrofit Lighting

### Comparison of Pre-Retrofit to Post-Retrofit Lighting DMV, Sacramento, CA

	EXISTING BASELINE	INITIAL RENOVATION DESIGN	IOLS RENOVATION	IOLS – SAVINGS OVER BASELINE	IOLS – SAVINGS OVER TITLE 24
<b>Ambient lighting</b>	Fluorescent troffers	Fluorescent troffers	Fluorescent pendants		
<b>Task lighting</b>	Fluorescent	Fluorescent	LED task lighting		
<b>Ambient LPD</b>	1.50 W/ft <sup>2</sup>	1.0 W/ft <sup>2</sup>	0.8 W/ft <sup>2</sup>	47%	20%
<b>Task LPD</b>	0.44 W/ft <sup>2</sup>	0.2 W/ft <sup>2</sup>	0.1 W/ft <sup>2</sup>	77%	50%
<b>Total LPD</b>	1.94 W/ft <sup>2</sup>	1.2 W/ft <sup>2</sup>	0.9 W/ft <sup>2</sup>	54%	25%
<b>kWh per year<sup>1</sup></b>	408,571 kWh	258,205 kWh	179,080 kWh	52%	24%
<b>Yearly cost (\$0.092/kWh)</b>	\$37,589	\$23,755	\$18,026	\$19,563	\$5,729
<b>Lighting retrofit cost<sup>2</sup></b>		\$315,000	\$330,000		
<b>Incremental cost to implement IOLS<sup>3</sup></b>		\$15,000	<b>Simple payback on incremental cost</b>	<b>2.6 Years</b>	

<sup>1</sup> Assumes 3012 hours of operation per year for ambient lighting, 2080 hours of operation per year for task lighting, and a 10% savings from the addition of an occupancy sensor. Calculation for 5th floor only (75,640 ft<sup>2</sup>).

<sup>2</sup> Estimated cost for general lighting component, actual cost for task lighting.

<sup>3</sup> Incremental cost for energy efficient lighting includes an \$8,000 utility incentive from the Sacramento Municipal Utility District.

For more information, visit:

Finelite, Inc.  
[www.finelite.com](http://www.finelite.com)

California Lighting Technology Center  
<http://cltc.ucdavis.edu/content/view/333/295/>