



Lighting Research Program



Project 4.5 Integrated Classroom Lighting System

Funded by Finelite and California Energy Commission's
Public Interest Energy Research (PIER) Program

Project 4.5 set four broad objectives

- Bring together:
 - New technologies in an
 - Integrated system to provide
 - Better classroom lighting (ICLS)
- Use actual installations to prove ICLS works
- Turn the research into commercial products
- Help promote the use of the new system.

Targeted benefits included:

- Reducing eyestrain and glare
- Improving lighting on walls and faces
- Providing excellent lighting for A/V
- Balancing daylighting and electric lighting
- Increasing teachers satisfaction
- Reducing energy usage by 30% - 50%
- Keeping within the same construction budget

ICLS development steps included:

- Using CHPS work as a starting point
- Evaluating new and emerging technologies
- Verifying 96% reflective material works
- Building a working system
- Getting critiques from professionals
- Soliciting feedback from users (teachers)
- Using feedback to make ICLS better

ICLS elements include:

Indirect / direct luminaires that:

- Light the teacher's face, walls and reduce glare
- Light for A/V needs: cut veiling reflections but light desks
- Cut energy use by 37% to 1 watt / sq. ft.
- Meet school budgets.

Controls and sensors that:

- Let the teacher control lighting from the front of the classroom
- Improve acceptance of controls
- Adjust electric lighting based on daylight (manual & automatic)
- Offer options including dimming and whiteboard luminaires.

Plug-and-play interconnections that:

- Guarantee accurate, no-hassle installation
- Ensure components work together
- Reduce support and warranty costs.

How the system works:

General Mode: light faces, light vertical wall surfaces, cut glare

- Use 2-rows of indirect / direct luminaires
- Add new feature for teachers to set a 1-hour occupancy delay during test or quiet time
- Use 3100 lumen T8 lamps w/ 1.18 BF IS electronic ballasts
- Keep power to 0.95 watts / square foot
- Provide 55 – 80 initial FC on the desks
- Have a Teacher Control Switch in the front of the classroom



How the system works:

A/V operation reduces veiling reflections

- Screens and TVs look sharp
- Desks are well lit
- Teacher changes modes without losing eye contact
- Switch is conveniently located and clearly labeled



How the system works:

General Mode: light faces, light vertical wall surfaces, cut glare

- Notice walls and ceilings lighted
- But, look at the pull down screen
- Veiling reflections tend to wash out the image on the screen
- To get rid of veiling reflections, the teacher simply pushes one switch
- The lighting changes from “GENERAL” to “A/V MODE.”



How the system works:

A/V operation reduces veiling reflections

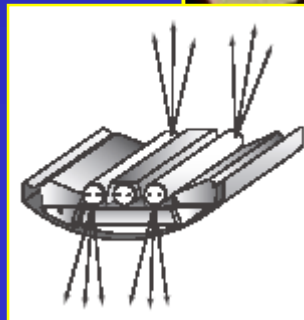
- Now, screens and TVs look sharp
- Due to the center down light desks are well lit
- Dimming can be added as an option. Note slide dimmer is clearly labeled



How the system works:

General Mode: Two outboard lamps are switch on

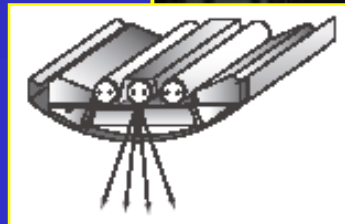
- The luminaire is wired so the outboard lamps are separate from the center lamp.



How the system works:

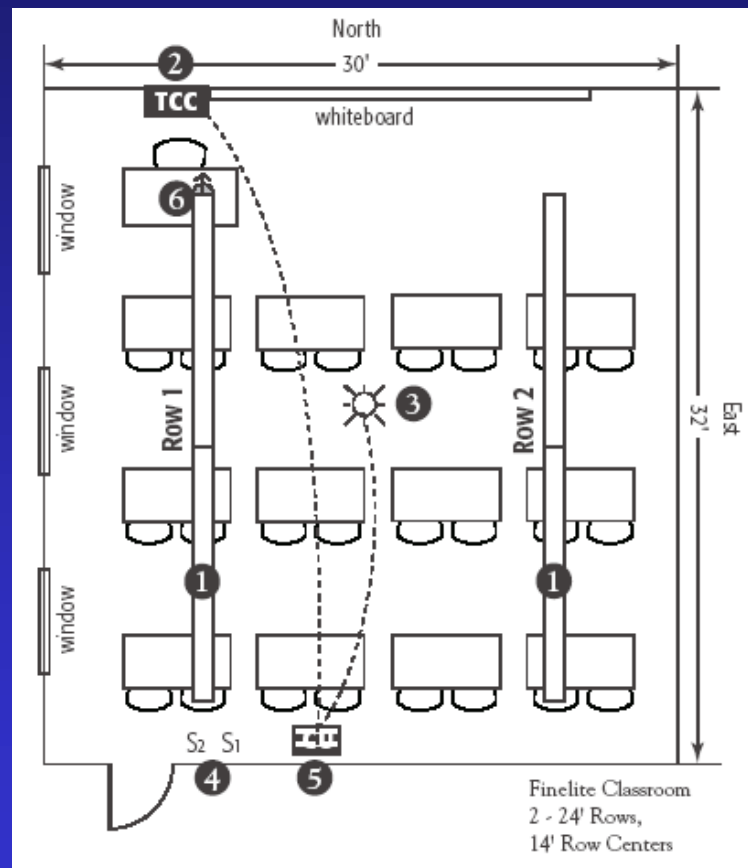
A/V operation reduces veiling reflections

- The center lamp is covered with 96% reflective reflector
- Directs 100% of light down



ICLS typical layout

- Luminaires
 - 2-rows
 - 14-foot centers
 - 24-inch suspension
 - Perpendicular to whiteboard
- Controls and sensors
 - TCC by whiteboard
 - Occupancy sensor in center of the room
 - Row switches by door(s)
 - Control Pack above door
- Interconnections
 - Low voltage
 - Plug-and-play between TCC, sensors, and Control Pack
 - Row switches (high voltage)



New ICLS features include:

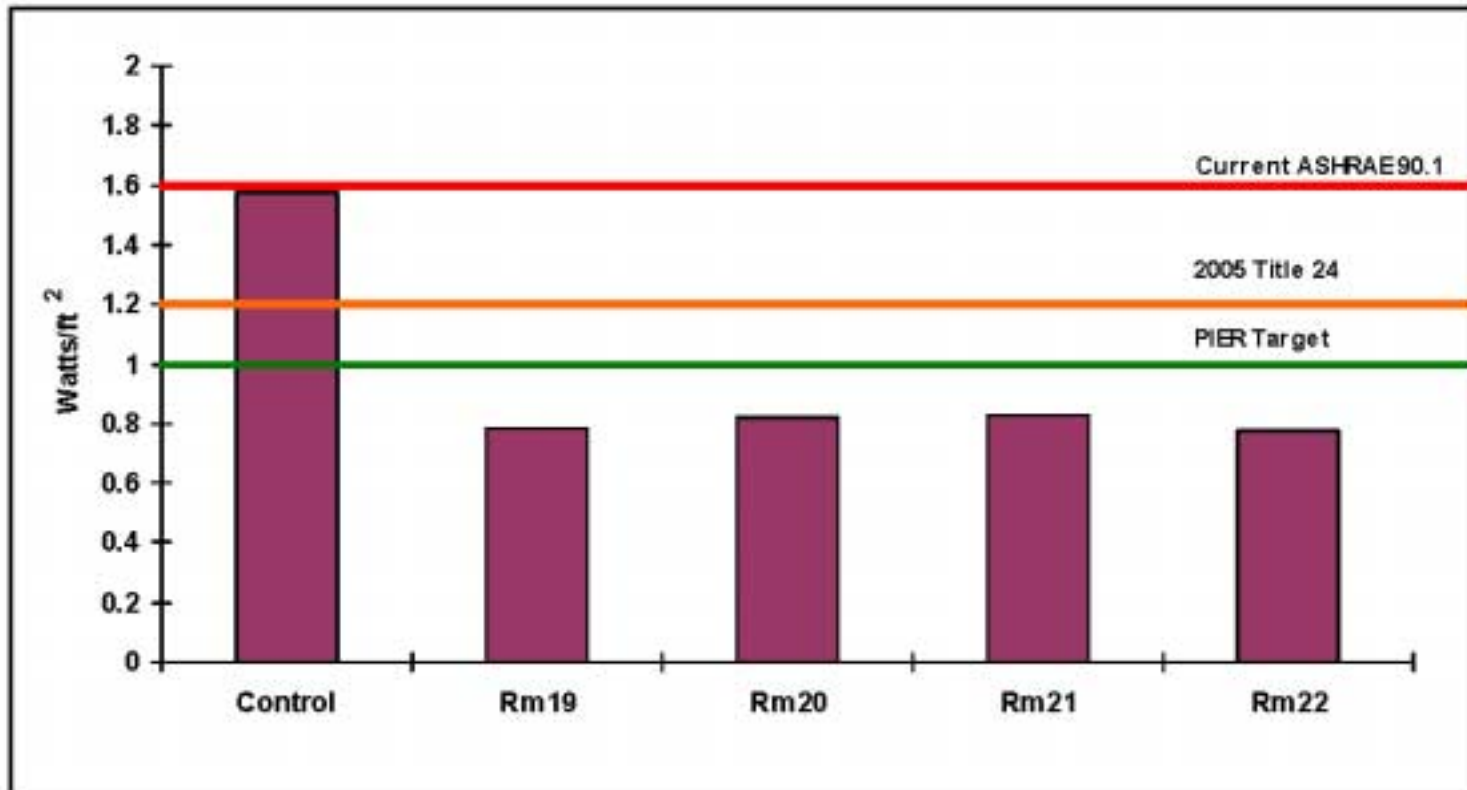
- More efficient luminaires (25% more light)
- 3100 lumen T8 lamps and 1.18 BF electronic ballasts (2-rows light a 32-foot wide classroom)
- Controls at the front of the classroom
- Occupancy sensors with unique “QUIET TIME 1-HOUR ON” mode - optimized for the classroom
- Plug-and-play interconnection
- Full-range support by one manufacturer
- Options for a wide range of classrooms.

Steps to verify ICLS performance included:

- Building a test system & classroom - **Done**
- Installing systems in 23 classrooms in 7 schools in 2 states - **Done**
- Using independent experts to:
 - Compare actual to expected light levels – **Done**
 - Get teachers initial feedback – **Done**
 - Get teachers final feedback – **Done**
- Monitoring energy usage each day – **Done**
- Extending the project to test daylighting controls and impact of a white board luminaire – **In process.**

ICLS is energy efficient

Heritage Oak 2003 School Year Effective Power Usage

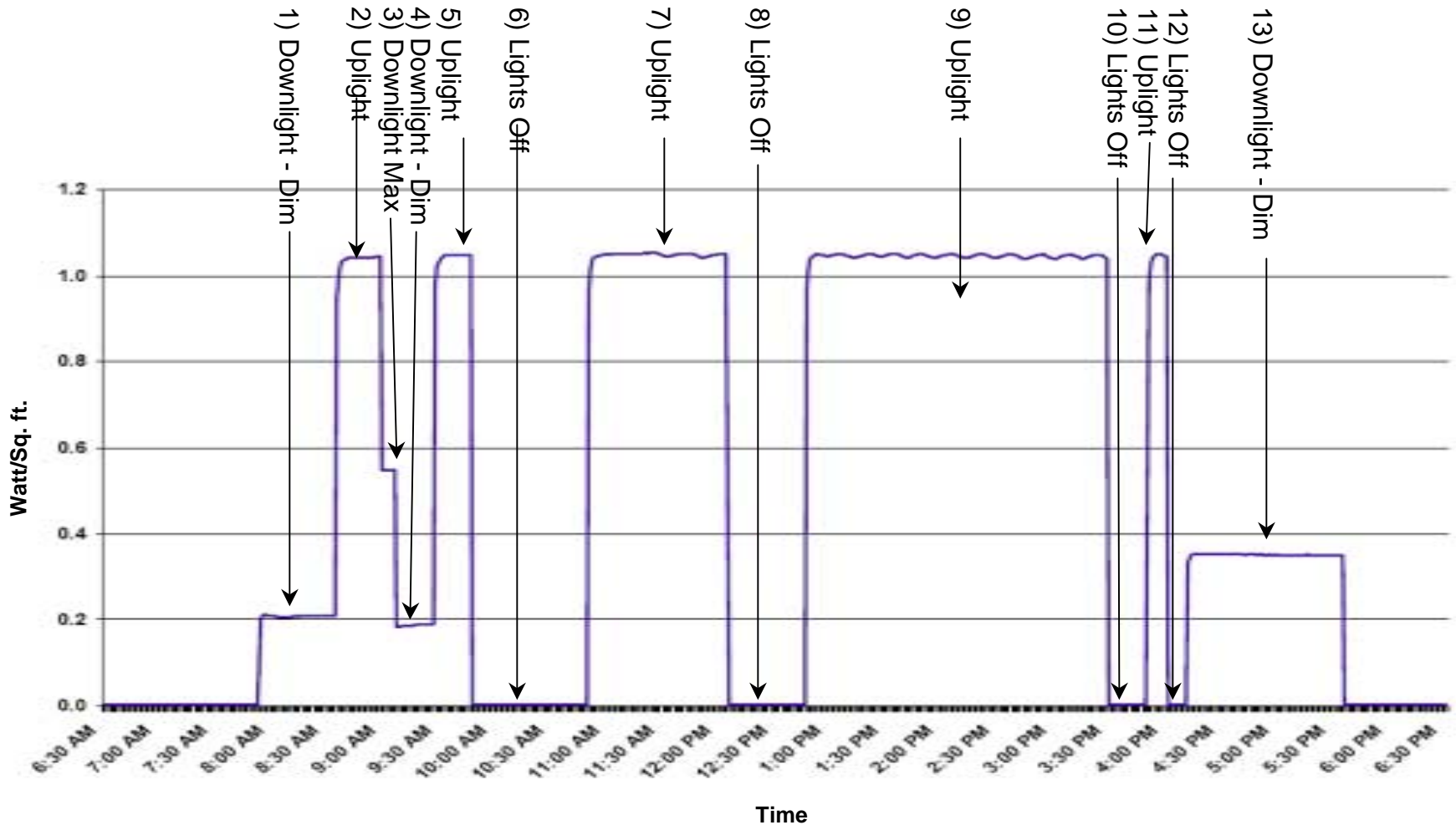


Data and analysis on energy usage included:

- Taking readings on energy each minute
- 14 classrooms successfully monitored
- Special software developed
 - Data was translated into an Excel format
 - Daily records can be extracted
 - Savings were identified
 - Yearly levels were calculated for the school
- Approximately 15 million data points exist
- Examples of data & analysis follow

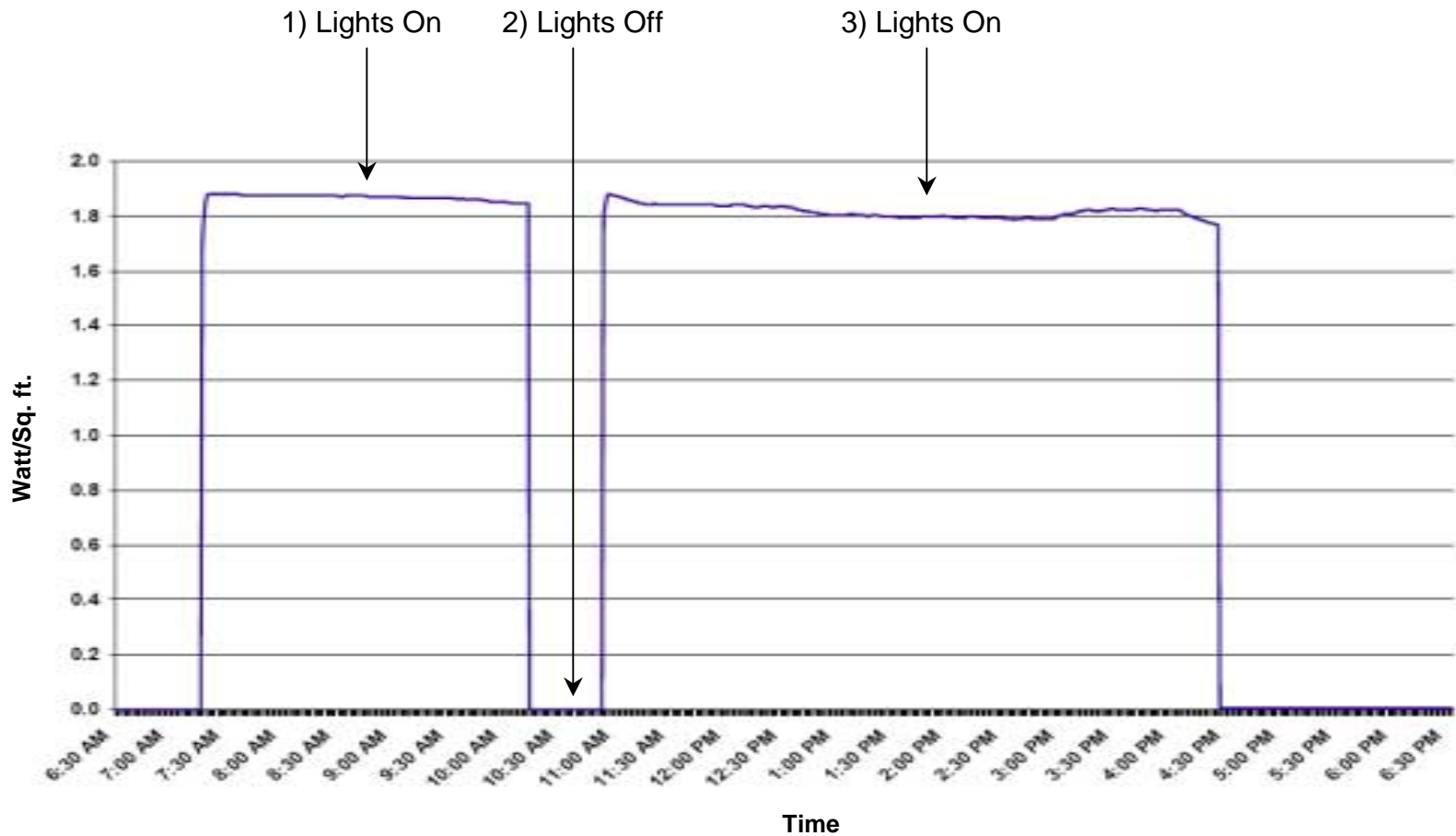
Lighting Usage –10/1/03

Heritage Oak School – Classroom 22



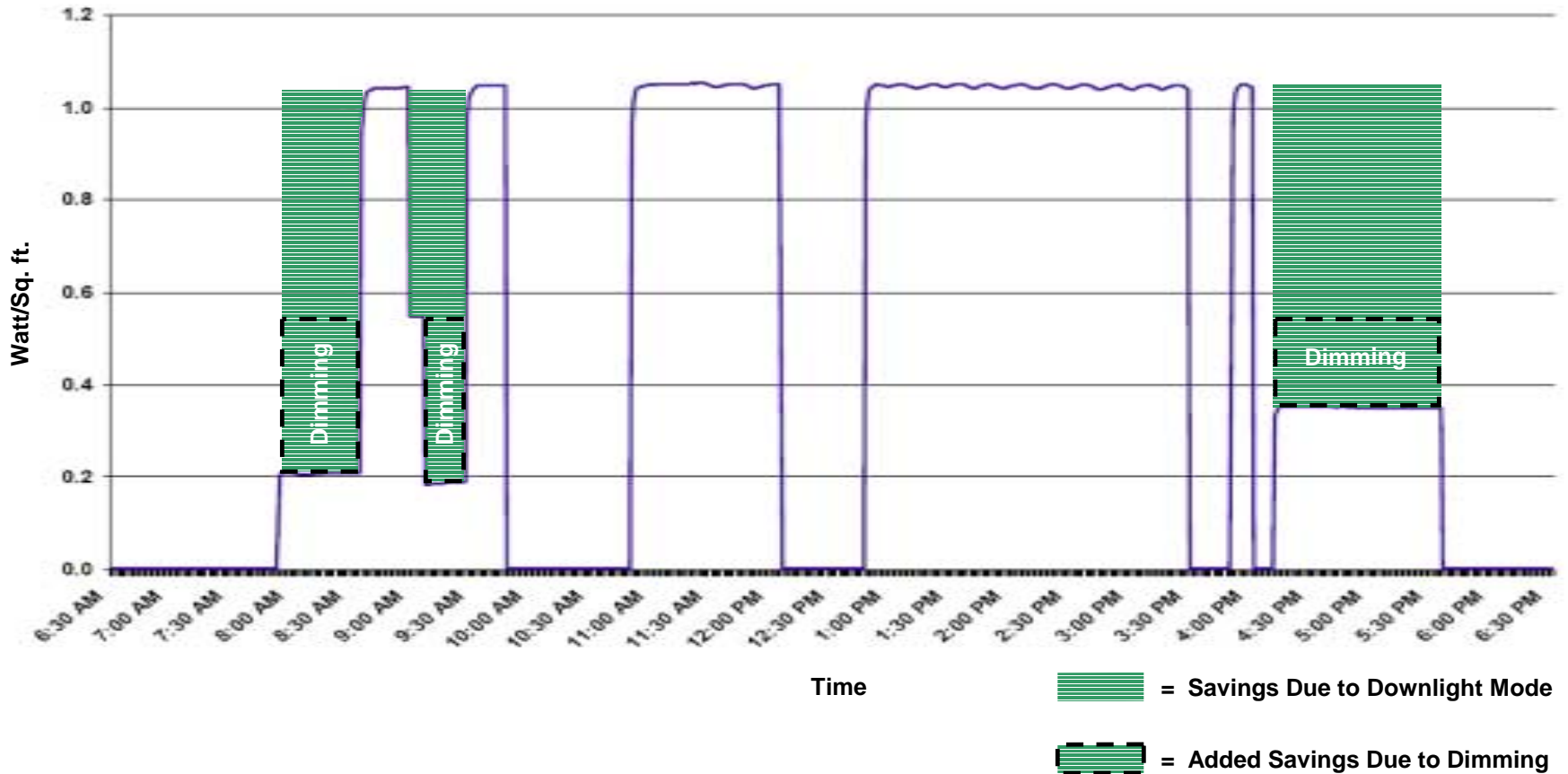
Lighting Usage –10/1/03

Heritage Oak School – Control Room18



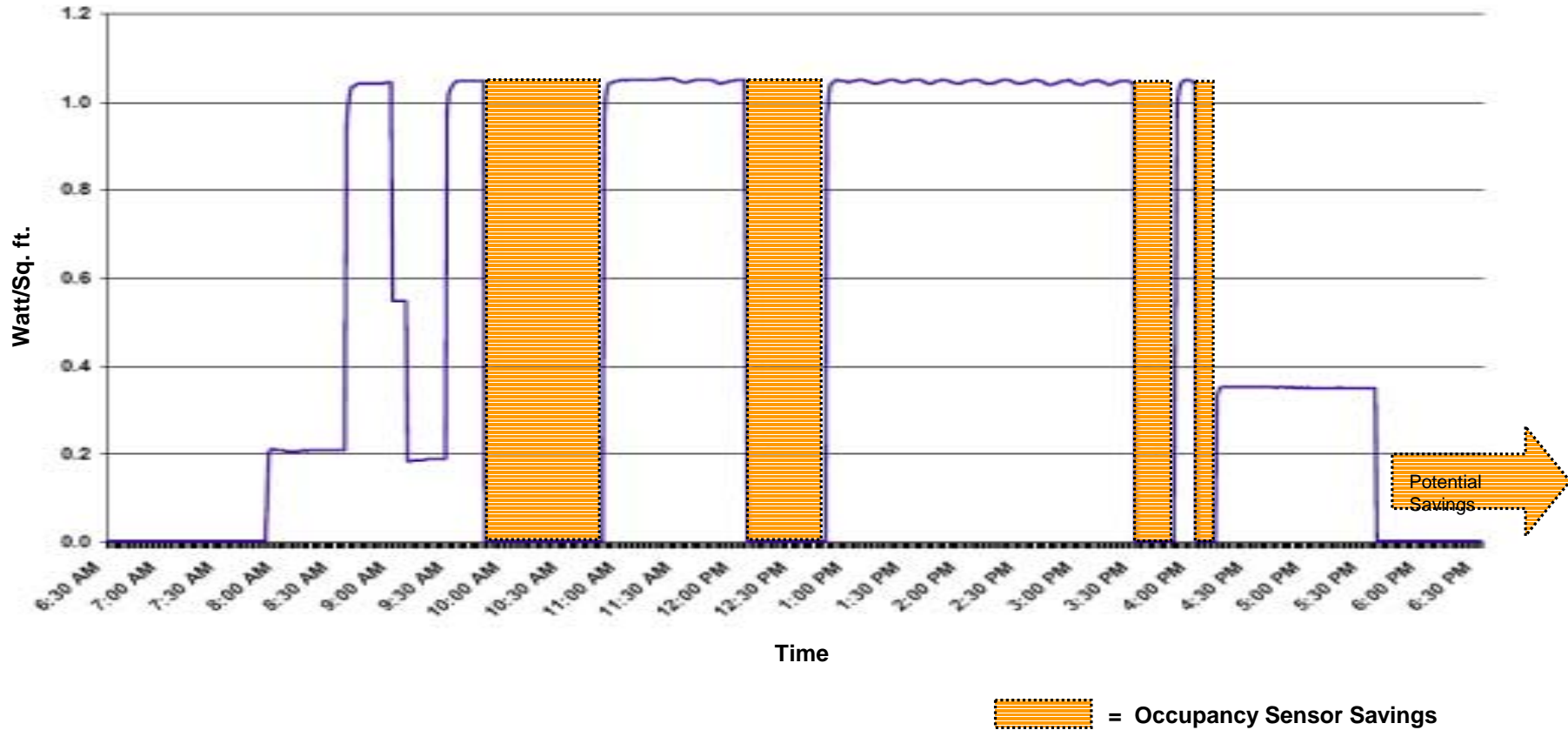
Lighting Usage –10/1/03

Heritage Oak School – Classroom 22



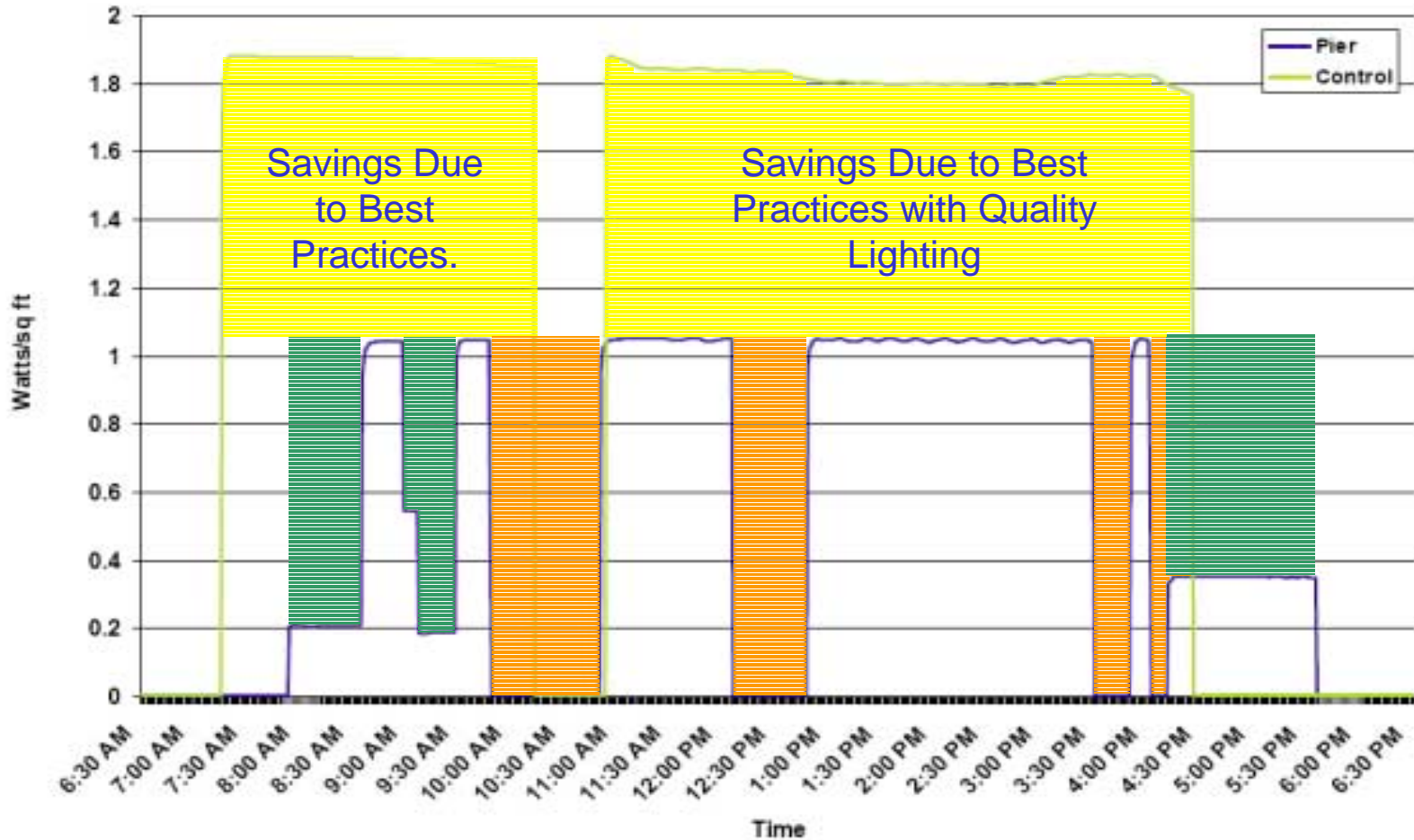
Lighting Usage – 10/1/03

Heritage Oak School – Classroom 22



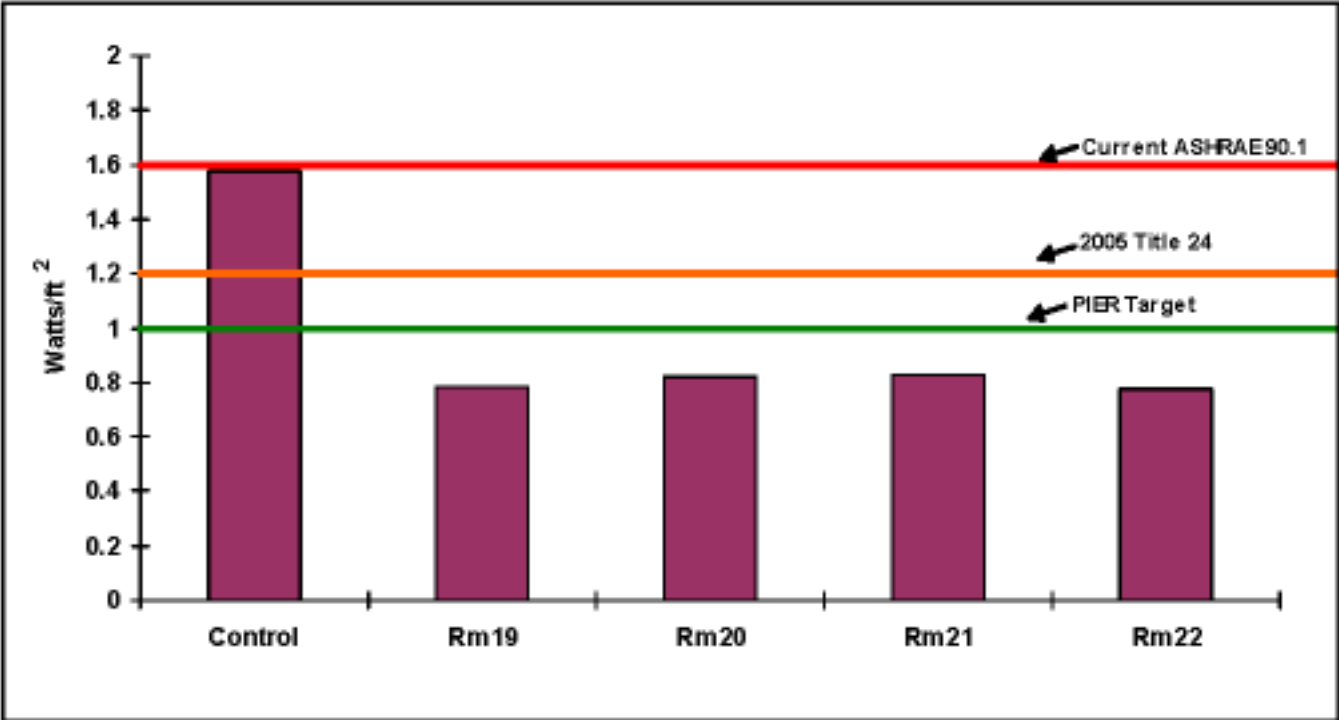
Lighting Usage –10/1/03

Heritage Oak School – Room 22



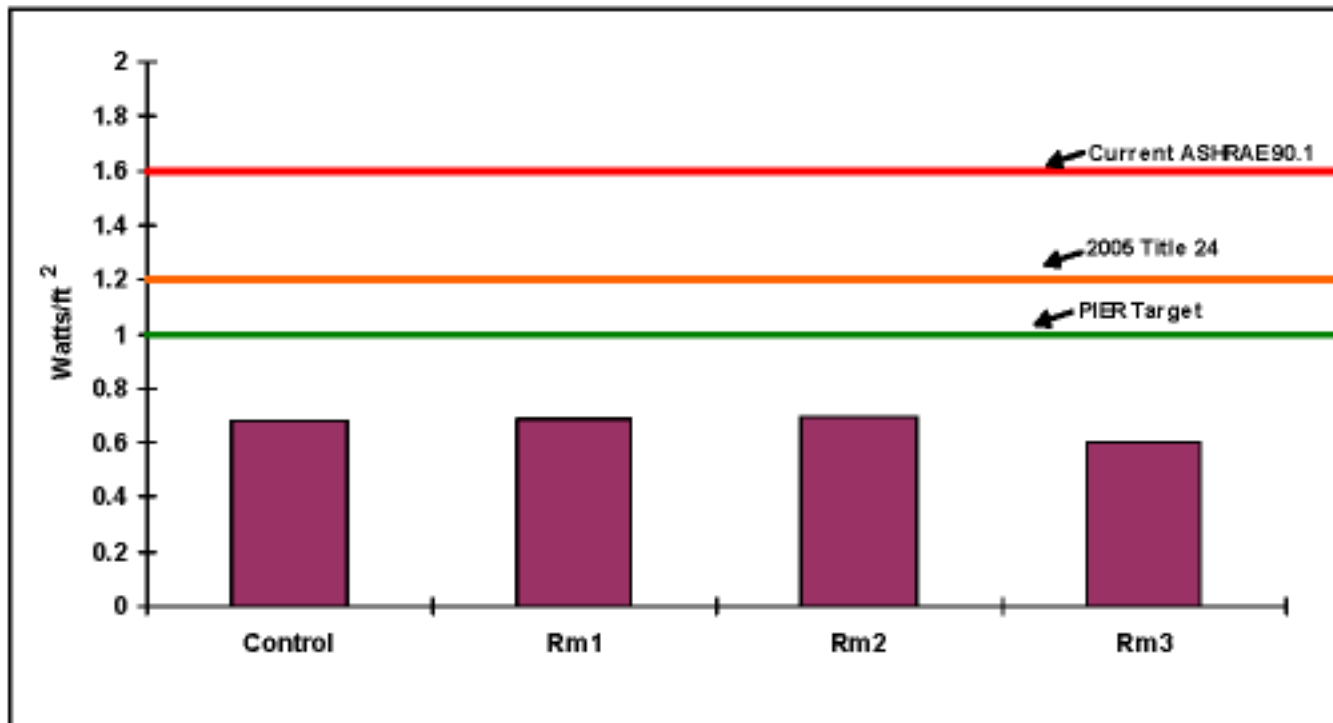
Heritage Oak Power Usage

Heritage Oak 2003 School Year Effective Power Usage



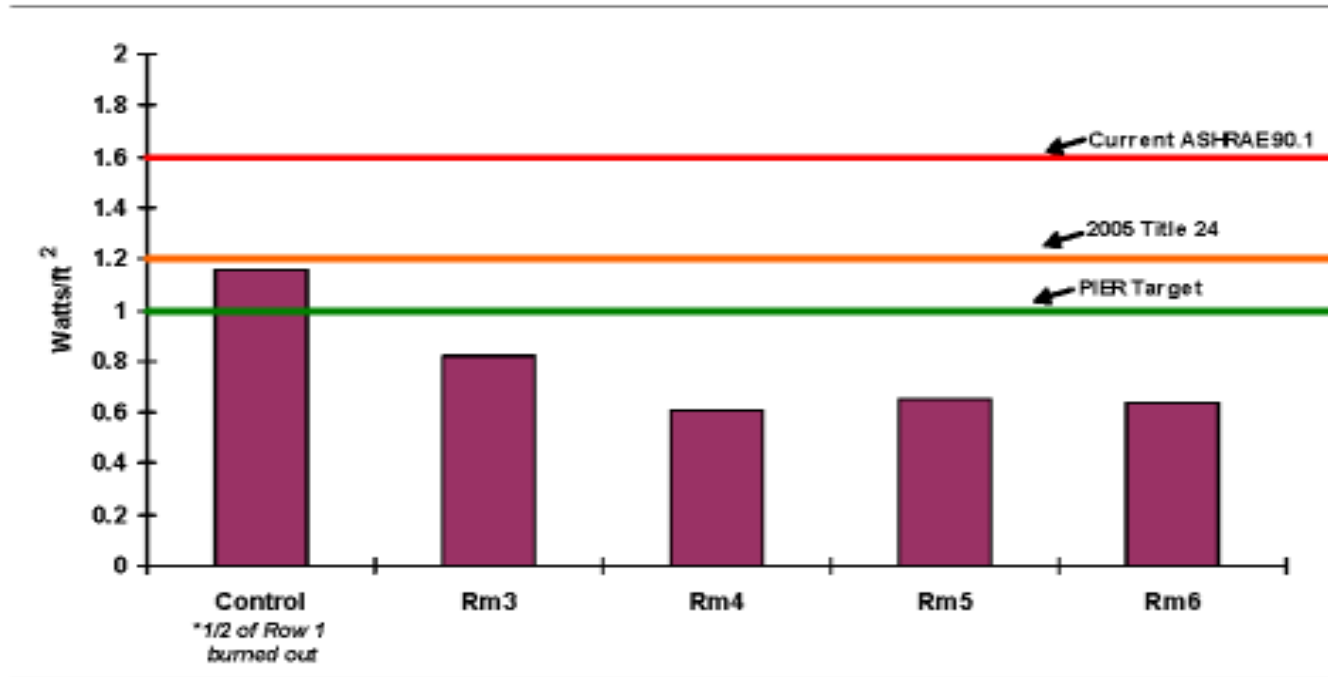
Country Club Power Usage

Country Club 2003 School Year Effective Power Usage



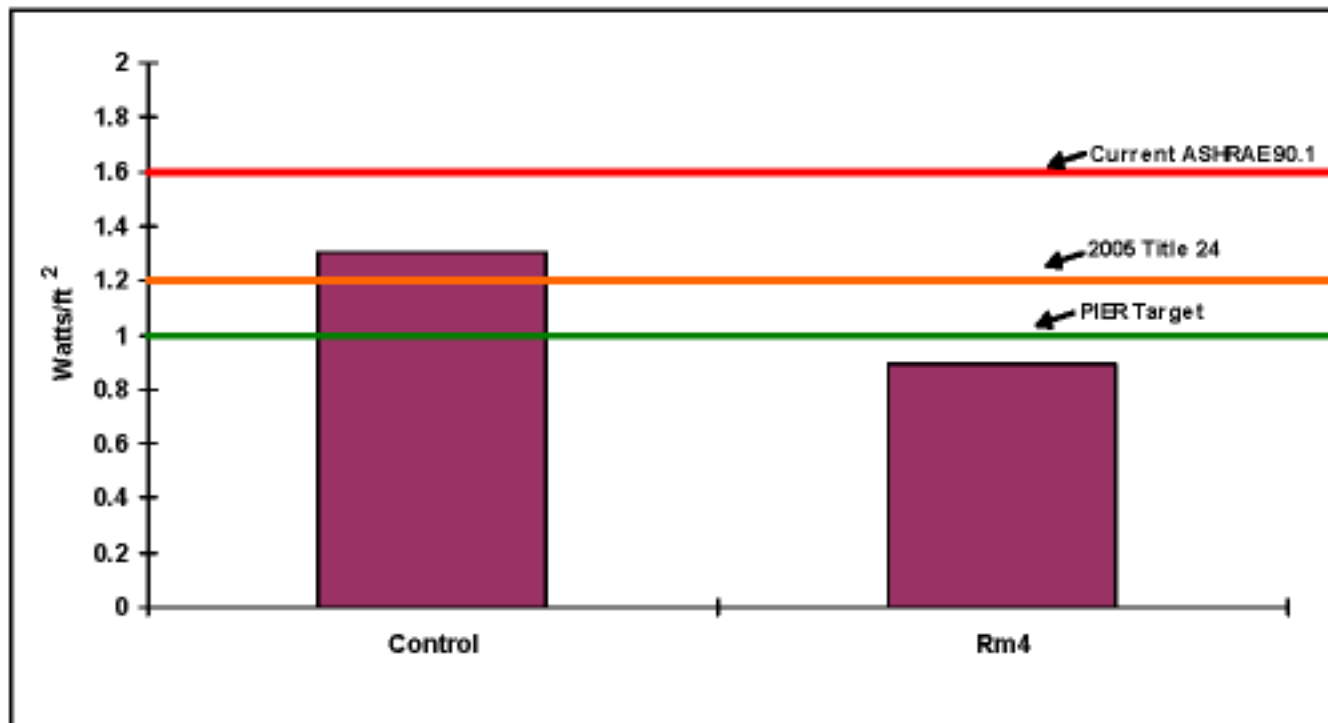
Dudley Power Usage

Dudley 2003 School Year Effective Power Usage



Carlmont Power Usage

Carlmont 2003 School Year Effective Power Usage

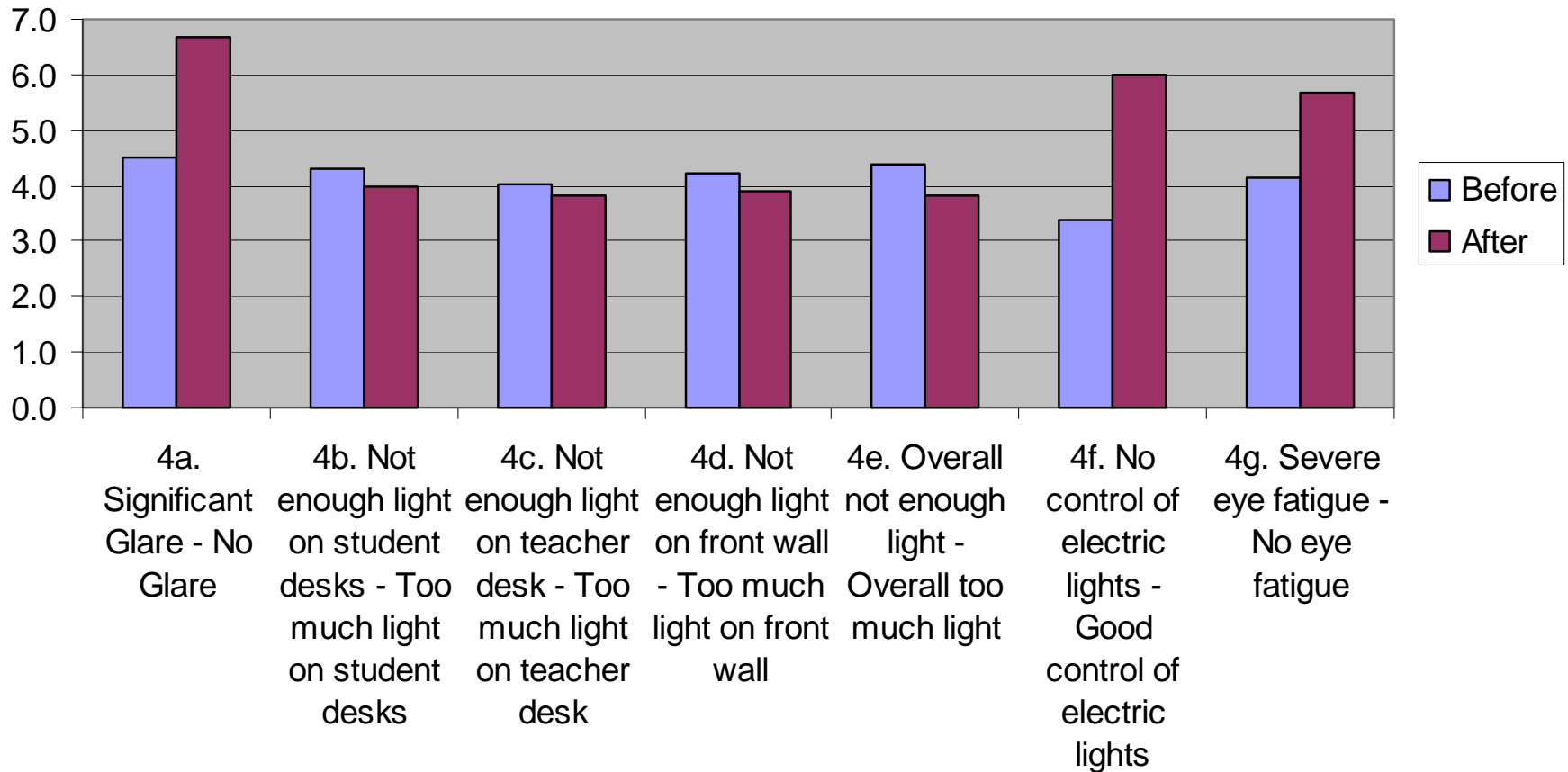


ICLS is cost effective

<u>Alternative</u>	<u>Installed cost</u>	<u>Difference</u>	<u>Energy</u> (watts / sq ft)	<u>Payback</u>
15 parabolics	\$2,745 (\$2.86 / sq ft)	0	1.35	None
ICLS System (A/V + occupancy)	\$2,600 (\$2.71 / sq ft)	-\$145	0.80	Immediate!
Daylight switching (each row)	\$175 (\$.18 / sq ft)	\$30	0.47	3-6 months
A/V Dimming (2 rows, 1-lamp)	\$500 (\$.52 / sq ft)	\$355	0.20	2 - 3 years
3 rd row (3 rows / room)	\$1,100 (\$1.15 / sq ft)	\$955	0.80	N.A.

Teachers prefer ICLS 9 to 1

Comparison of Classroom Comfort Before and After Lighting Change



Here are before and after photos of two ICLS test classrooms

- Heritage Oak – represents new construction
- Dudley Elementary – represents a lighting retrofit project. (There is tremendous opportunity to understand this area better.)

Heritage Oak control classroom (1.75 watts / sq foot)



Heritage Oak PIER system

(.8 watts / square foot)



Dudley Elementary School

(1960's vintage fixtures, 1.7 watts / sq ft)



Dudley Elementary School

(Low Voltage Retrofit, .9 watts / sq ft)



ICLS is such a new concept that “Awareness” is a major issue. Examples include:

- Teachers don't know what they are missing
- Schools are looking at different issues
- Specifiers are not yet aware of ICLS
- Project managers already “know” they can't afford it
- Contractors are afraid of it
- Traditional sales channels see it as a threat
- However, folks who experience it want it.

Steps to build “Awareness” include:

- Creating an AIA-CEU course - Finelite
- Developing ICLS Spec Sheets - Finelite
- Negotiating statewide ICLS prices - Finelite
- Building a statewide sales channel - Finelite
- Giving more seminars on Classroom Lighting (CHPS, SCE, CASH, and Light Fair 2005)
- Installing ICLS in additional classrooms
- Creating and distributing more case studies

Conclusion

- ICLS benefits are real and well-tested
- Building “Awareness” is our next challenge
- Thank you for your support