

Lighting Demonstration Showcase Effectiveness Study – Energy Training Center

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ABBREVIATIONS AND ACRONYMS

PEC	Pacific Energy Center
ETC	Energy Training Center (Stockton, Ca)
PP	Percentage Points

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EXECUTIVE SUMMARY

PROJECT GOAL

The primary objective of the study is to measure the impact of the lighting installations and demonstrations at the Energy Training Center (PG&E training facility located in Stockton, CA) to increase the participants' knowledge of and likely adoption of the new and innovative lighting technologies designed to improve energy efficiency.

Specifically, objectives include:

- Measure pre- and post-levels of knowledge regarding the lighting products demonstrated,
- Determine the likelihood to purchase, recommend, install, or specify the lighting products demonstrated, and
- Measure ratings of the lighting products demonstrated in regard to key characteristics. Some of these characteristics include: cost, energy savings, quality, controllability, ease of retrofit/installation, durability, and reduced maintenance.

PROJECT DESCRIPTION

To meet the study objectives, a hard-copy survey was used to collect feedback from class participants at the Energy Training Center. In total, 64 surveys were completed among the participants.

PROJECT FINDINGS/RESULTS

The results indicate the lighting demonstrations successfully improve participant familiarity with the advanced lighting products. Further, the demonstrations successfully influence the participants to act on the products demonstrated (i.e. recommend, specify, purchase, install, and seek additional training).

The *energy savings* from the lighting products is the most frequently mentioned benefit, which would lead Energy Training Center participants to recommend the products, followed by the products' *longevity* and *light quality*.

When asked for suggestions for improving the demonstrations, participants most frequently mention *providing more specific, detailed interactive demonstrations, providing more/better printed handouts and materials, and offering more or continuing the classes with a larger selection of days and times*.

PROJECT RECOMMENDATIONS

The lighting demonstrations should not only be continued but should also be considered for expansion through classes at other locations, additional lighting products demonstrated, and invitations to more professionals with the empowerment to purchase, specify and install the products.

BACKGROUND

In the summer of 2012, the Emerging Technologies program at PG&E collaborated with PG&E's training center in Stockton, California, the Energy Training Center (ETC), to update existing lighting installations in three rooms and one hallway – replacing what are now generally considered to be standard fixtures in terms of technology and energy efficiency, with newer, more advanced lighting and control technologies. The lighting classes offered at the ETC are directed at internal and external parties, including customers, contractors, designers, architects, installers, low income segment outreach specialists, and other trade allies. As a rule, the audiences and focus of the demonstration lighting installations at the ETC tend to include more installers, contractors, efficiency auditors, and internal-to-PG&E low income energy efficiency outreach specialists. The wide array of fixtures installed in rooms at the centers will enable a lighting class instructor to demonstrate and compare multiple types of light fixtures and technologies and discuss the advantages and disadvantages of each.

This report analyzes the surveys gathered after demonstrations to five different classes held at the ETC in September and October 2012. All five demonstrations were performed in the ETC's 'residential classroom' (RCS), which was the most extensively retrofitted of the three rooms that were updated.

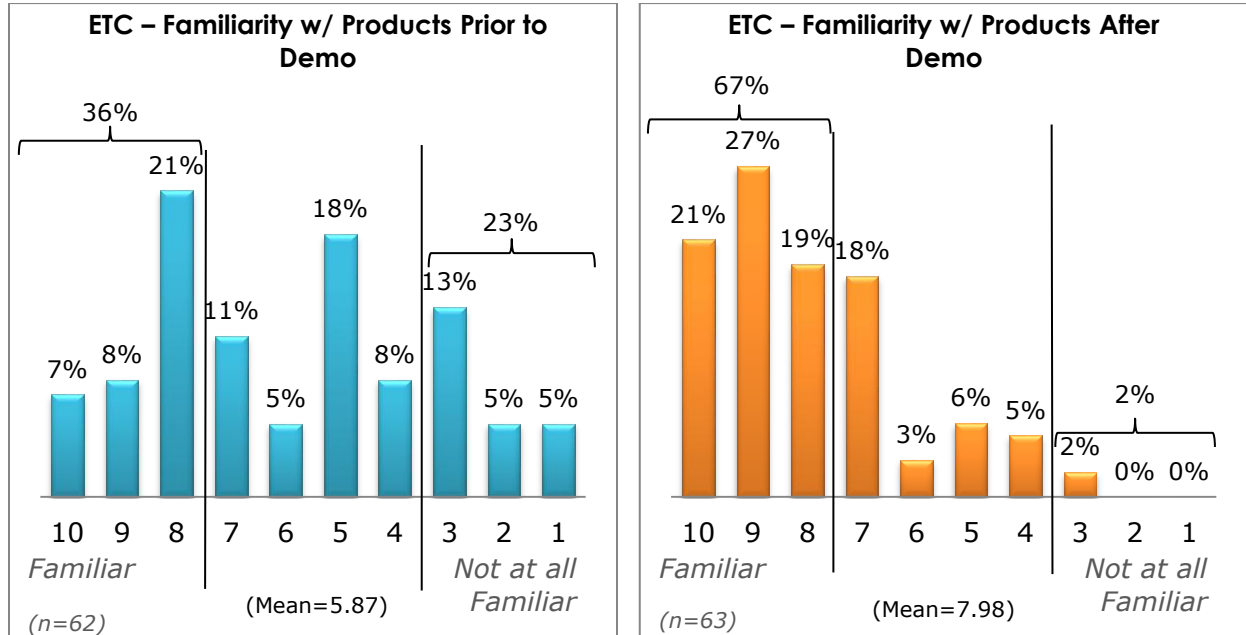
ETC DEMONSTRATION SCHEDULE

Schedule of classes at the ETC during the course of which the class participants observed a demonstration of the newly installed advanced lighting.

ENERGY TRAINING CENTER (ETC) STOCKTON, CA			
CLASS DATE	EVENT	# SURVEYS	# TOTAL PARTICIPANTS
9/25/2012	Evolving Lighting	4	5
10/05/2012	Miscellaneous Demonstrations	5	5
10/12/2012	Energy Outreach Specialists	17	17
10/23/2012	Ligthing for Industrial, Warehouse, Greenhouse, Food Processing	12	14
10/30/2012	Retail Energy Expert (class developed for employees of a large chain of hardware supply stores based in California)	26	26
	Total	64	67

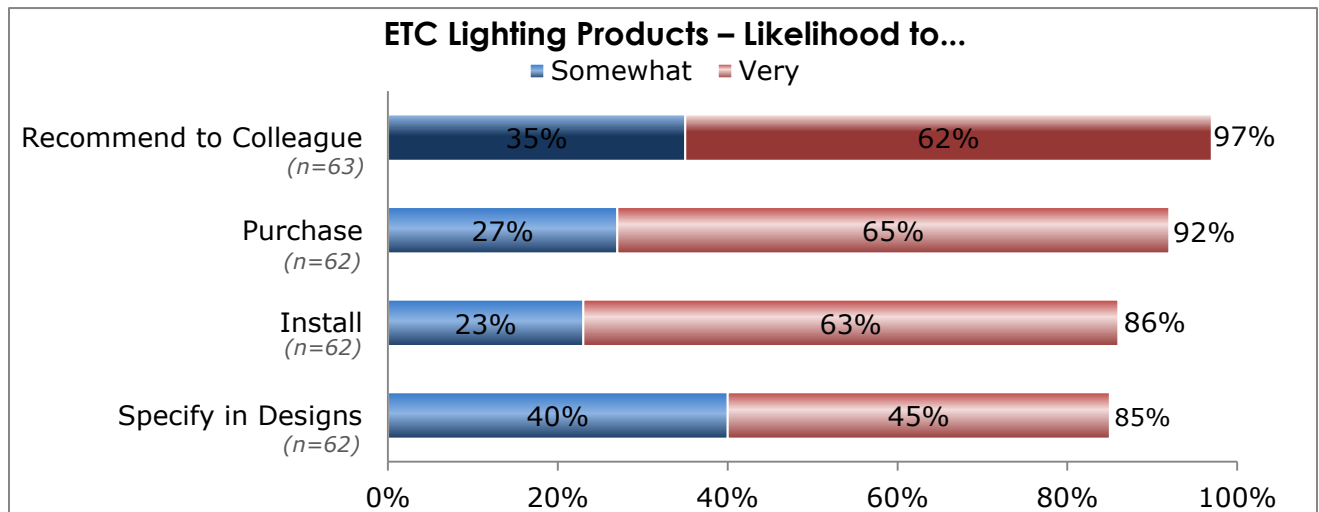
RESULTS

Of those who attended a demonstration at the ETC, familiarity with the lighting products improves dramatically (up 31PP to 67% 8-10 on a 10-pt. scale), leaving only 2% of participants unfamiliar with the products.

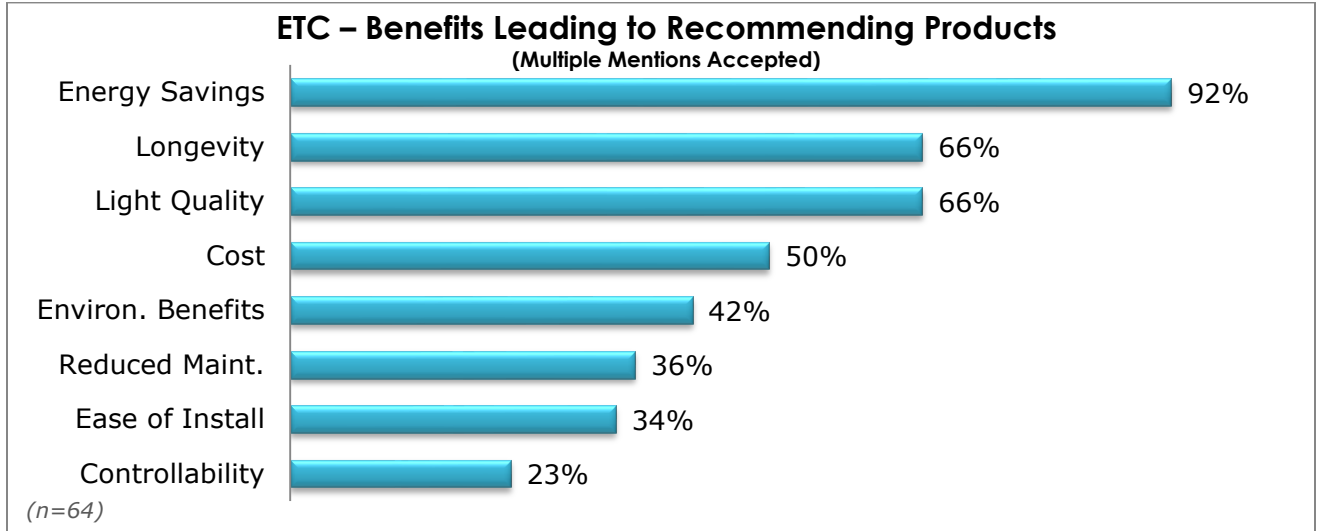


Note: Proportions may not add to 100%, due to rounding.

Nearly all ETC participants are likely to *recommend a lighting product to a colleague* and *purchase a lighting product* (97% & 92%), while a notable majority are likely to *install a lighting product* or *specify a lighting product in designs* (86% & 85%).



The *energy savings* (92%) from the advanced lighting products is the most frequently mentioned benefit, which would lead ETC participants to recommend the products. Also mentioned by a majority include the products' *longevity* and *light quality* (66% & 65%).



ETC participants most frequently suggest *more specific, detailed and interactive demonstrations* (28%), followed by *provide more and better printed materials or handouts* (17%).

ETC – Suggestions	Proportion
More Specific/Detailed/Interactive Demonstrations	28%
Provide More/Better Printed Materials/Handouts	17%
Offer More/Continue Classes/Larger Selection of Days/Times	11%
Nothing/Satisfied	37%
Sample Size	18*

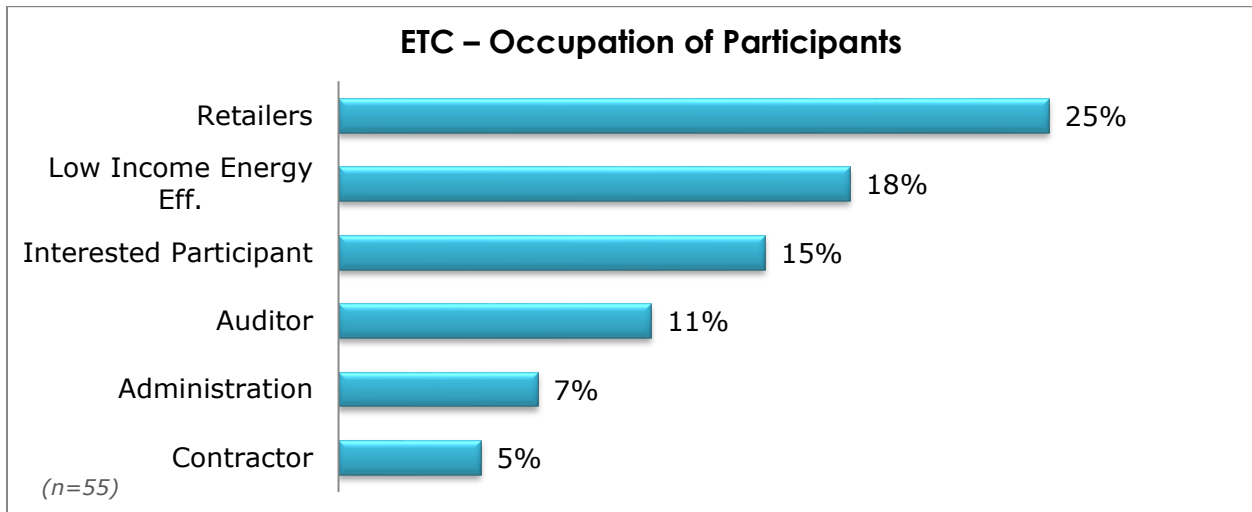
*Low sample size; results should be reviewed with caution.

Verbatim Comments:

"More actual lighting demonstrations with current and future types of lighting products."

"More simpler and condensed handouts. More interactive features."

One-fourth (25%) of ETC participants are *retailers*, followed by *low income efficiency outreach specialists* (18%).



RECOMMENDATIONS

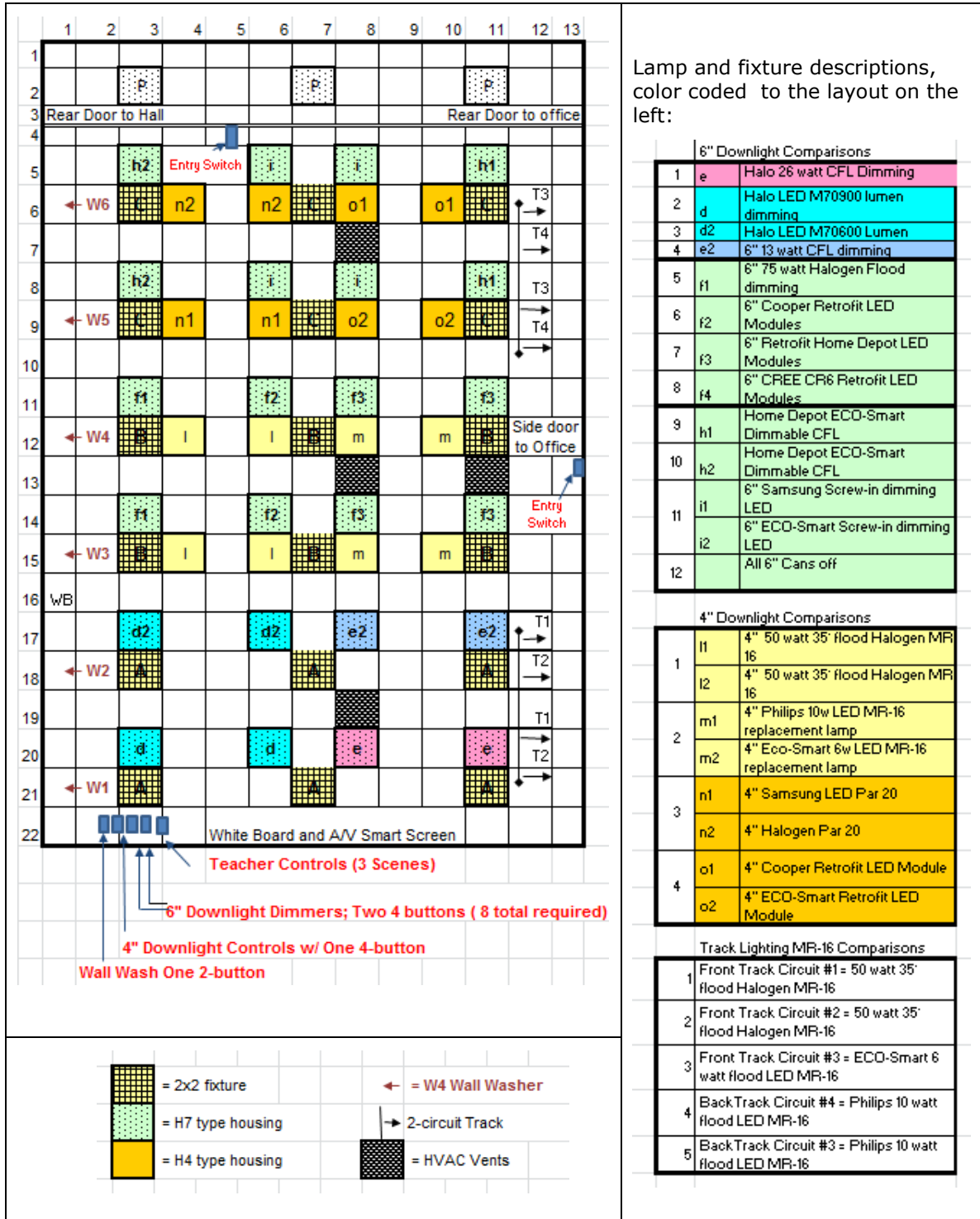
Continue conducting lighting demonstrations, and consider expanding the demonstrations by offering classes at additional training locations with a larger selection of days and times. Further, consider demonstrating other emerging technologies.

Through advertisements in trade publications and direct communications, strive to increase class attendance among professionals with the empowerment to purchase, specify and install the products. Such communications should focus on the energy savings from using the products, as well as the products' light quality and longevity.

Review all class materials and handouts to determine if the information can be consolidated and/or simplified.

Appendix LIGHTING LAYOUT IN THE 'RCS' CLASSROOM

Of the three rooms at the ETC that were retrofitted, the RCS classroom, which measures 36' by 25', was the most extensively retrofitted, and in which the demonstrations occurred.



DEMONSTRATION SCRIPT, OR NARRATIVE

The script, or narrative, below, was written by David Alexander, Senior Energy Solutions Manager in the Customer Energy Solutions department and lighting subject matter expert at PG&E. David designed the layout of the lights for the RCS classroom at the ETC and performed the majority of the demonstrations surveyed in this report. David did not intend the 'narrative' to be read verbatim during a demonstration, rather to serve as a guide for demonstrating the various types of lighting applications in the room.

Stockton ETC Lighting Retrofit Demo and Evaluation – Narrative

A. Intro to Space

We are in the Residential Classroom and you can see that there is a variety of recessed down-lights, track lighting and 2x2 troffer's. When designing this room we wanted to provide a showcase of lighting technologies for Residential and Small-medium business and provide instructors with a comfortable environment for teaching. This room measures 36 x25 or 900 sq. feet. Later we will discuss T24 implications.

B. Intro to Fixtures

First thing you notice is that almost every 2x2 square has a fixture. We wanted to show you various lighting products/fixtures that can be used in commercial buildings and residential homes for retrofits and/or new construction. The fixtures are grouped by types with a legend available up here at the front of the room.

The 2x2 fixtures provide general illumination during classes and show the latest in T5 and LED. Next we have typical 6' recessed down-lights and 4" down-lights that we can swap in and out various retrofit solutions. Our Low-Voltage Track Lighting on the side walls will allow us to compare Halogen and LED solutions. On the other side of the room we have low voltage wall washer fixtures in both Halogen and LED. These provide us a wall wash effect to light up white boards, but also will allow us to show beam angle and demonstrate color choices in LED.

C. Intro to Controls Solutions

From the front of the room we have five banks of switches. These switches will provide you with an opportunity to view and make comparisons between various lighting sources. These switches are part of the Watt-Stopper Digital Lighting Management system. There is no panel associated with these controls. Instead individual room controllers are placed at each fixture grouping. These are then daisy chained with Cat-5 Cables and RJ-45 connections from controller to controller and to switches.

At the two entrances to the room we have entry switches. These are a single button that when pushed turns on the front at a 50% level the middle at 25% and the rear at 10%. This provides a suitable space for instructors to prepare

Located in the room are two Dual Function Occupancy sensors. These are Auto on/off. When activated the sensors only turn on the center 2x2's at 50% for pass thru lighting. They are set to walk thru mode. In this mode if the sensors don't pick up any additional motion after 30 seconds they shut off in a minute. If motion and activity are present after the initial 30 seconds then sensors times out after 10 minutes of activity.

The first bank of switches as you face them provides scene control over the 2x2 fixtures for general illumination as a classroom. The first button will turn all 2x2's to 100%. The second button provides Audio Visual Presentation mode, which turns the front six 2x2's off, then dims the middle six 2x2's to 50% and leaves the last six at 100%. The third button is all 2x2's at 50% and the final button provides a Video mode with the first six all 2x2's at 10% and the balance at 25%.

At each bank there is a Master Dimming touch controller followed by individual buttons that allow us to turn on and off the different types of fixtures. Touch a button and the associated grouping will turn on. Tap the button twice and the blue led will blink, now touch the dimming controller. Continue tapping the buttons to turn on and off groups. Caution, if you touch the master dimming switch first, it will turn on or off all lights. Don't worry just turn off the ones you don't need and continue having fun.

For more information on the controls visit www.wattstopper.com and checkout the Digital Lighting Management resources

D. Lighting Technologies Comparison

Let's take a tour of what we have and start talking about what you notice as we compare within each type of fixtures, the performance of the technology in terms of energy use, dimmability, color and general light quality

a) 2x2 Volumetric fixtures

You will notice that we have 18 fixtures that all have an identical design. These fixtures are provided by Cooper, they are the Metalux Accord series. There is a mix of LED and T5 Fluorescent. Can you spot the LED fixtures?

Many manufacturers have developed similar fixtures. This type of fixture provides even illumination. The enhanced vertical illumination eliminates the cave affect associated with Parabolics. The design minimizes the shielding zone for better visual comfort.

Type A 2x2 fixtures at the front of the room are speced with F14T5/841k Fluorescent T5 lamps. The ballast is 0-10vcontrollable and able to dim the lamps. With a fixture efficiency of 89%, this fixture draw 30 watts provides 2400 lumens providing 80 LPW.

Type B is the 45 watt version with 3450 lumens and Type C is the same fixture with 2630 lumens at 33 watts. Both fixtures are 3500 kelvin with a rated CRI of 85. At full wattage this room consumes .71 watts per foot. Do you know what the allowed wattage per square foot is for Office, Classroom, Conference room? Does this room meet T24?

Do you feel Light levels from the 2x2 fixtures are adequate for office and classroom's. How much do you feel we could trim(dim) these fixtures? What change will that make to T24?

b) 6" Downlights

There are 12 pairs of 6" Downlight housings. 6" housing are very common in residential and smaller commercial buildings. One of the more common designations you will see is H7 referring to the Halo Brand. However, there are many manufacturers; so much of the retrofit product will be designated to fit 6" housings or H7 Housings.

As you look around you will see we have Halogen, CFL, and LED downlights. We can compare 75W Halogen with only 12W LED downlights, and we see how much more light we have. We have many different LED fixtures, from screw-in LED Screw-in PAR lamps to retrofit modules/trims that can be quickly changed out.

From the front of the room we have dedicated lamp technologies with 26 watt CFL that incorporate dimming ballasts, to the left of that is a 900 Lumen LED fixture. Almost all LED's are dimmable by nature. How much difference do you see in the technologies? The 26 watt CFL is actually using 28watts and the lamp is 1800 lumens. The LED version is 900 lumens and uses less than 15 watts. This will give an idea of fixture inefficiencies in CFL & Incandescent down-lights.

The next row back compares a 13 watt non-dimming CFL to a 600 Lumen LED fixture. This was one the early Designs with heavy heat-sinking for thermal management. What do you think the heat sinking does for the Life of the product? Versus cost?

The next row starts with a Halogen then is followed by three Retrofit Modules/Trims that are available from retail DIY Home Improvements centers in the \$50-\$70 range and a low price of \$35. Any thoughts on why the cost has come down on these? Anyone know how much the rebate is for a Non-residential (Business) customer? Answer \$30 per fixture

The final rows show some Screw-in options including Dimmable R30 CFL's. Thoughts?

c) 4" Downlights

There are 8 pairs of 4" Downlight housings. Again Halo is very common in the market and the designation of H4 is very common, so there are many manufacturers of retrofit products that will be designated to fit 4" housings or H4 Housings.

Here we start with Halogen MR-16's in low-voltage fixtures. The most common solution is going to be a LED MR-16 replacement. In this case we have Philips 10 watt and a Home Depot 6 watt Replacement lamp.

Further back starts with a Halogen PAR20 compared to the LED Par 20 lamp followed by two retrofit Modules/Trims. Again these are available from retail DIY Home Improvements centers in the \$50-\$70 range.

d) Wall washer Downlights

Wall wash lighting is becoming more common in the home. It is not only used to highlight art, but can be found creating visual interest in cabinets and libraries. We have six fixtures all similar in size and design the first three fixtures are low-voltage halogen MR-16 lamps. You should not see too much difference in these.

The three to the back incorporate LED Light Engines. These are not replacement lamps like those we see over here in the 4" down Light's or in the Track fixtures. These LEDs are able to dim with an Electronic capable dimmer. In our installation we installed a non-dimming room controller that will be replaced later with a dimming room controller.

What do you notice? You should see three different colors. This further demonstrates the available choices in LED, but also we can use this to show how color impacts artwork and clothing in our design choices. Also notice how much center beam intensity there is with these fixtures.

e) Low-Voltage Track Lighting

We installed two sections of two circuit track. This will allow us to compare at least four different MR-16 Replacement lamp solutions. Two start we have the typical 50 watt Halogen 35° flood (EXN). This is probably the most common of all Halogen MR-16 lamps. At the back we have LED MR-16 Replacement lamps with Philips 10 watt and Home Depot 6 watt products. As we look at the wall we can really see the illuminance difference between the sources. Also as I dim the sources note the color shift? Do you see any flicker? Flicker is a big concern with Low-Voltage transformers; the six watt lamp will flicker more than the 10 watt. But look at same lamp in the 4" down-light, the flicker is almost not visible. In one exercise we had all 6-watt lamps installed and the flicker was horrible. This might be due to circuit loads on the dimmer or a difference in the transformer design.

What is another Energy Efficiency option for Halogen MR-16's? We can demonstrate 35 watt Energy Saver versions of the same lamps or a 20 watt MR-16 with a narrower beam spread.

E. Dimming Capabilities

Now it's time to compare dimming capabilities of Halogen, LED and FL fixtures. What was your first thoughts of dimming? What happens when Halogen dims? Are we seeing the same thing with LED?

Let's look at the Dimming of LED Mr-16's in our track Fixtures?

F. Coming soon



In the future we will be installing retrofit modules from Juno. Their new products are marketed as Warm-Dim. These products resemble the Incandescent characteristics in that as they dim the color shifts to a warm color. Why would that happen? Who would this appeal to?

In the back corner we are planning a table with several common table lamps. These will be fitted with CFL's and LED A-lamps that can be found at most Retailers and Distributors.

Red, Green, Blue are the primary colors that make up white light. Two displays will demonstrate the mixing of color. Using the back wall we will install a track light with three separate heads, one of each color. Individually they will show the one of the colors. Blended together they provide white. Our other display will be a Channel letter where we will have installed the three colors in LED and a White LED strip. This will demonstrate how colors interact with surface materials.

G. Evaluation forms

This room provides you with an opportunity to sample and compare lamps and retrofits. We invite you to bring product that you are interested in and sample them in our fixtures. Don't have a lamp; let us know what you're interested in and we will find them for you.

At this time we would like to provide you with a questionnaire. Please provide us with your feedback about this room as a demonstration tool.