Northwest Trade Ally Network
Commercial & Industrial Lighting

EnergyTrust of Oregon

Welcome!

Increase energy savings…

Improve lighting quality…

…in a rapidly changing lighting environment

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Goals for Today

Overall goal: Increase kWh savings & quality of lighting

- Impact of Federal requirements – preparing for the future
- Review new products with promise
- Options for increasing savings beyond "one to one"
- Leveraging NW TAN and utility support to create more results

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Energy Independence and Security Act (EISA)

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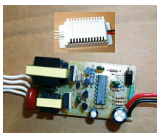
Lamp and Ballast Update



Dawn Doberenz, LC

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Fluorescent

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1938

From the Facility Blog
Author Heidi Schwartz, Oct 12, 2011

Imagine that the year is 1938.

- You buy a brand new Chevy, the technological marvel of its era.
- Now imagine it's 2011 and you're still driving the same car for your daily commute.

Far-fetched?
Not if you substitute **T12 fluorescent lighting** – first marketed in 1938 – for the '38 Chevy.

True: We've seen an astonishing array of new lighting and automotive technology since 1938.

Also true: No one we know of drives a 73-year-old car for daily commuting, but some 500 million T12 fluorescent tubes are still being illuminated in U.S. buildings every day.

That will start to change on **July 14, 2012**, however, when commonly used T12s will no longer be manufactured in – or imported to – the United States.

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EPACT Regulations

July 14th, 2012

Most standard T-12's AND SEVERAL T8's will no longer meet the standard

- For Linear T-8's:
  - 89 lumens per watt < 4500 Kelvin
  - 88 lumens per watt > 4500 Kelvin
- 8' Slimline:
  - 97 lumens per watt < 4500 Kelvin
  - 93 lumens per watt > 4500 Kelvin
- 8' T12 HO
  - 92 lumens per watt < 4500 Kelvin
  - 88 lumens per watt > 4500 Kelvin
- 2' U-bent (6', 3", 1 5/8")
  - 84 lumens per watt < 4500 Kelvin (All T-12's, T-8 SP's are eliminated)
  - 81 lumens per watt > 4500 Kelvin

Ewing-Foley, Inc
Manufacturers Representative

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What will utilities be doing after EISA ?

- Reduced incentives?
- Promoting options beyond T12 to T8
- T8 to reduced wattage T8
- Controls
- LED (or other new technologies)
- Redesign the space
- Cost effective options
- Check with utility programs

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T8 lamps

Era	Series	Watts	Lumens	CRI	Life
1st generation	700 series, basic, standard	32	2800	75-78	15-20, 000
2nd generation	800 series	32	2850–3000	82-86	24-30,000
3rd generation	Super, Premium, High performance	32	2950-3100	82-86	24-42,000
4th generation	Reduced wattage – Energy Savers	23 25 28 30	2000 2400 2750 2850	82-86	24-42,000 Temperature Sensitive

Most Utilities require T8 lamps/ballasts to be Consortium of Energy Efficiency (CEE) listed

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Osram 800XP/XL Ecologic Lamps

SYLVANIA

EXtended Performance EXtended Life T8 Lamps

- Available in Full wattage (32W) and two SUPERSAVER® versions (28W and 25W)
- 60,000 hours at 12 hour starts
- 97% lumen maintenance , 85 CRI
- Meet CEE requirements

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Who are Contractors out in the audience?

Who are the distributors?

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Question

- We are continuing to see increases in lamp pricing but expect it to level off as other suppliers start-up
- What is the latest on rare earth metals related to linear T8 lamps?
- Input from the audience?

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T8 Ballasts

Ballast Factor (BF) = Measured ability of a particular ballast to produce light from the lamp it powers; ballast factor is derived by dividing the lumen output of a particular lamp/ballast combination by the lumen output of the same lamp on a reference ballast.

Ballast Factor	Light output	Math	Notes
Low Ballast Factor (.78)	70 – 85%	3100 x .78 = 2,418	Aka: Reduced light output (RLO)
Normal Ballast Factor (.88)	86-100%	3100 x .88 = 2,728	Aka: Normal Light output (NLO)
High Ballast Factor (1.15)	101-120%	3100 x 1.15 = 3,565	Aka: High Light output (HLO)

Most Utilities require T8 lamps/ballasts to be Consortium of Energy Efficiency (CEE) listed

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Know program start and standard ballast info.

Series vs pararell Ballast.

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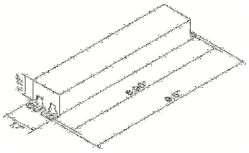
PHILIPS ADVANCE

Introducing New **Optanium® T8** Programmed Start Parallel Ballasts

Part Numbers	IOP-4PSP32-SC, IOP-3PSP32-SC, IOP-2PSP32-SC
Lamp Types	4 Ft. (32W), 3 ft. (25W), and 2 ft. (17W) T8 lamps , Also compatible with 4 ft. (30W), (28W), and (25W) energy saving T8 Lamps
Ballast Factor	0.88 for primary lamps
Input Voltage	IntelliVolt® 120V to 277V
Starting Method	Programmed Start



Can Size
(Same size as existing T8 programmed start products)

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Philips T5HO New Family

F54T5 HO **54** Watts 5000 Lumens

F54T5 HO EA **49** Watts 5000 lumens
10% energy savings with equal lumen output, 40,000 hours

F54T5 HO XEA **44** Watts 4520 Lumens
20% energy savings, 10% reduced lumen output, 40,000 hours

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Introducing **Optanium® T5HO**

Programmed ***S***tart ***P***arallel Ballasts

Quick Overview

- Fluorescent fixed output ballasts for use in high-bays with occupancy sensors and frequent switching applications

Key Features

- Lower input watts
- Independent lamp operation
- Faster starting in less than 1 second
- Smaller size for the 2-lamp version
- Optimized for use with **Philips Energy Advantage 49W Lamp**

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Owners can sometimes pass on upgrade cost. so dont shy away from lease spaces!

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Bitar Office Complex

Portland, OR

Existing Equipment:

- Total 273, 4 lamp T12 acrylic lens troffers

Retrofit Equipment:

- Total 273, 2 lamp T8 high performance lens kit
- Low ballast factor (BF) ballast, 3100 lumen lamps

Results

- Annual kWh Saved – 100,611 (3,050 annual hours), 59% ROI
- Total Annual Cost Savings = $10,147
- Light levels – from 40FC's to 46FC's
- Improved quality of space:
  20 Tenants and owner are pleased with results

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Question

If your customer has an office complex with 4 lamp T12 acrylic lens troffers, is it possible to retrofit the existing fixtures to T8 lamps/electronic ballast, de-lamp and still provide the appropriate light levels?

Yes – Use High Lumen, High Performance T8

Yes – Adjust ballast factor accordingly
(3100 x 1.15 = 3565 lumens per lamp)

Yes – Office is most likely over lit

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LED Replacement lamps

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Energy Trust of Oregon LED project results

- February 2010 – added prescriptive incentive for LED recessed downlites
- February 2011 – added prescriptive incentive for screw based LED replacement lamps
- 2011 kWh LED savings through October = 2,668,435 (17,083 downlites and replacement lamps installed)

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EnduraLED Portfolio (Reflector)

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- Energy Star: Over 300 products are now qualified

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DOE sponsors L Price contest.

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L Prize A19: 60W Incandescent Equivalent

- Power: 10W/120V
- RAL: 25,000
- CRI: 90
- CCT: 2700K
- Lumens: 900lm
- Energy Star Equivalent: 60W
- Available Q1 2012

L•PRIZE℠ WINNER

PHILIPS ADVANCE

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DOE on LED Integral lamps

There are some high performing LED replacement lamps

- Most LED lamps tested fail to meet basic performance levels of the incandescent or halogen lamps they appear to replace
- Trying to message "how much light do you really need" to consumers
- Pacific NW Lab continues to test LED lamps "off the street" in their CALiPER program. See list on website: http://www1.eere.energy.gov/buildings/ssl/caliper.html

Lighting Science Group

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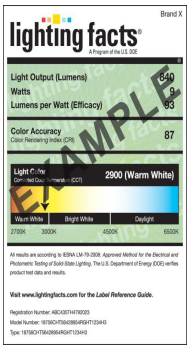
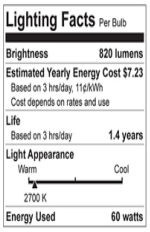
LED labeling

on commercial boxes



DOE Lighting Facts Label	FTC Label
All LED fixture and lamp types	Medium screw base only
LED only	LED, fluorescent, incandescent, and halogen
Voluntary	Mandatory
Not required on packaging	Required on packaging
Label for buyers and utilities	Label for Consumers
Lifetime not listed	Lifetime listed
LM-79 testing required, claims verified by DOE, and ongoing QA	No testing required for LED, Manufacturer Reported Claims

On Retail boxes



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How to Qualify an LED Product

http://www.lightingdesignlab.com

Step 1:	Check the national LED lists to see if your product is already listed. If it is, STOP! You do NOT need to continue.
Step 2:	Check the LDL LED lists to see if your product is already listed. If it is, STOP! You do NOT need to continue.
Step 3:	If your product is not listed on the above lists, complete the LDL LED Manufacturers checklist.
Step 4:	Submit the completed checklist and all required documentation listed (LM79 report, warranty, product spec sheet and NRTL certification) to ledlist@lightingdesignlab.com.
Step 5:	For an integral LED lamp, submit product sample within 30 days.

- Please allow 3-4 weeks for our review.
- To check on the status of your request, see the LED List Status on our website.
- See the LED Specifications for requirements to be on the list.

Puget Sound Energy · Seattle City Light · Snohomish County PUD · Tacoma Power · Bonneville Power Administration · Idaho Power · EWEB · EnergyTrust of Oregon

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Question

What light source do you think our business customers ask about most regularly?

A- Candle lighting
B- Daylight
C- LED

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Dimming Fluorescent

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plug in examples of warehouse and office

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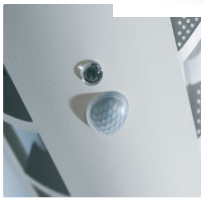
Daylight Harvesting

- Step dimming (switching)
- Control ballasts on separate circuits
- 1/3rd, 1/2 or 2/3rds or entire fixture
- Dimming ballasts (down to 3%)

Examples

- Warehouse with skylights
  - Bi-level or full dim
- Office space with windows
  - Full dim ballast with photo cell



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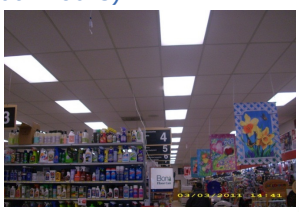
Ace Hardware

Existing Equipment
- Qty (140) 4 lamp T12 acrylic lens troffers, dual switched

Retrofit Equipment
- Qty (140) 2 lamp T8 with step dim (bi-level) ballast
- Owner wanted dual switch capabilities to remain

Results
- Annual kWh Saved – 66,243 (3,800 annual hours)
- Total Annual Cost Savings = $4,989
- ROI = 181%
- Dimming not included in savings



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Question

Are there other applications where dimming ballasts may benefit a customer?

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Induction

Up to 100,000 hour rated lamp life

- Lumen maintenance 70% at 60,000 hours
- Efficacy of 70 to 75 lumens per watt
- Usually able to use half the wattage as HID source and get close to same amount of light output

Source: Osram Endura/Sylvania Icetron™ Electrodeless Lamp

Best applications have high labor cost.

- Parking garages
- Cold-storage rooms
- Inaccessible roadway tunnels and underpasses
- Illumination of roadway signs and inaccessible advertisement boards
- Lighting over stairs or escalator wells
- Open mall atriums or ceilings in "big box" retail areas
- Pole-mounted luminaires for dusk-to-dawn illumination on a campus

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BPA requires ben testing if going into an existing fixtures

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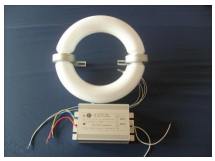
Induction retrofit options

Questions to ask:



BDT, DIY

1. *Retrofit option tested by the manufacturer? Warranty for the retrofit measure?*
2. Warranty on lamp and driver? (3 to 5 years with the rated life)
3. How long has the company been in business?
4. What about the existing HID ballast?
5. Is it UL or ETL listed?
6. More appropriate solutions for the application? (Linear fluorescent, etc.)

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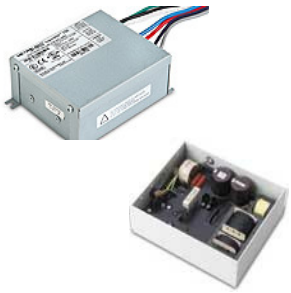
Electronic HID



Metrolight, Venture

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Can controls be used?
Yes!

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Oregon Iron Works

Existing Equipment
- Qty (50) 400watt
- Qty (9)1000watt Metal halide Hi-bays

Retrofit Equipment
- Qty (50) 450watt electronic HID solution

Results
- Energy Savings - 26%
- Annual kWh Saved - 62,736
- Total Annual Cost Savings = $4,472
- ROI = 29%
- Light levels from 30FC to 45FC

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The Elite MH Story

- **Warm & Cool white light** (3000K & 4200K)
- **210 & 315** watt systems
- High **system energy efficacy** for energy saving and low cost of ownership (115~120 lm/W & >92% driver efficiency)
- Optimized on **standard lumen package**
- **Compactness** offers optimization in design of optics and luminaires
- Best **optical efficiency** (up to +10%) and thus lower investment
- Long **service lifetime** lamps and exceptional high gear lifetime (3 years & 50~60 khrs)
- Bright and stable over life **color quality**

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Question

What are some other applications where electronic HID may be appropriate?

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Introduce Manufacturer's rep

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Lighting Design Approach for Additional Savings

Section 2 table of contents:

- Going beyond one for one
- The components of the lighting system
- The lighting design process

Doug Oppedal, LC

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Show an example if possible.

1. compare two lighting calculators

2. show pictures if possible

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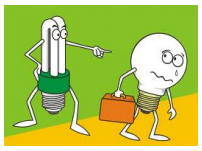
Beyond lamps and ballasts

- Demo or recycle old lighting system
- New luminaires or kits (including a new lens)
- Less luminaires and/or lamps than existing layout
- Lower LPD than existing
- Possible lower light levels
- Adding controls
- Could involve new circuitry
- Includes all lighting measures in the space, nothing left out



1 for 1 is done!

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Concept

- Think of the space as new construction
- Meet lighting power density requirements (Local energy codes)
- Meet light level requirements (IESNA)
- Implement controls per code
- This methodology WILL save more energy

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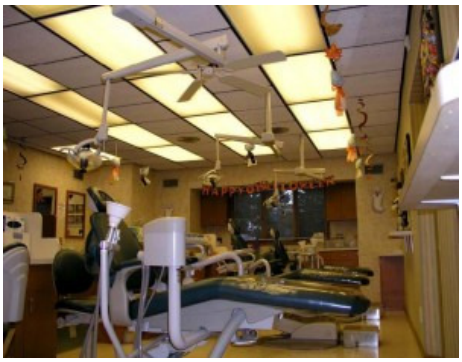
Is this going beyond one for one?



Before

After

give examples of ways to sell project without T12

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Current market / Future market

- What are you finding & doing with current comprehensive projects?
  - One for one or ?
- This could be an incentive option for many utilities in the future
- NEEA is currently testing pilot projects and programs in the Northwest region
- How will you sell projects after 2012?
- The T12 to T8 hayride may become a kiddy ride

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Understanding Components of a Lighting System

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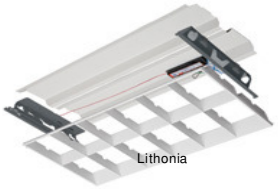
Fixture Efficiency - How Many Lumens Exit Luminaire?



TOTAL LUMINAIRE OPTICAL EFFICIENCY = 89.1 %

TOTAL LUMINAIRE OPTICAL EFFICIENCY = 85.0%

"Luminaire efficiency is the percentage of light output produced by the lamps that are in turn emitted by the luminaire. Not all light produced by the lamps will exit the luminaire; some will remain trapped inside and dissipate as heat. The luminaire's physical characteristics will affect how much light will exit and how much will be directed at the workplane."

Craig DiLouie – lightnowblog.com

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fixure efficiency is what really allowed the space to get to .75w/sf

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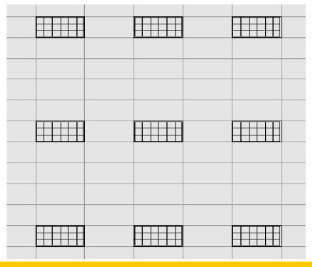
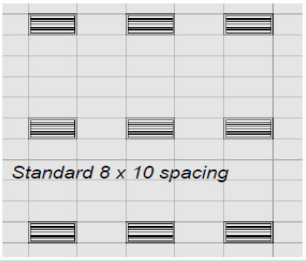
Design Considerations

Design Example

Basic Recessed Designs for Offices





Generic Parabolic T8 System
3 lamp T8 system
51 footcandles at 1.125 w/sf

Latest T5 System, Basket-style
2 lamp T5 system
48 footcandles at 0.75 w/sf

AB™ target LPD for offices: 1.1

Advanced Buildings CORE PERFORMANCE
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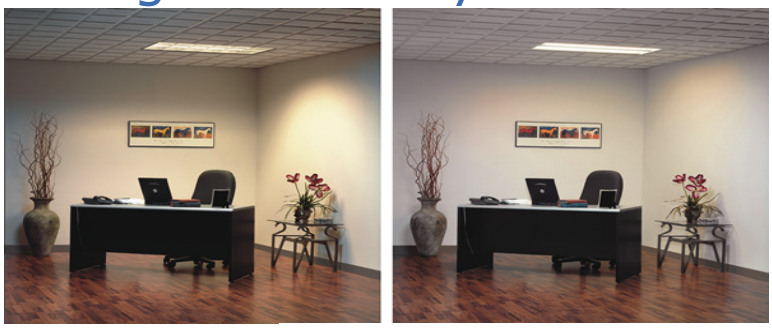
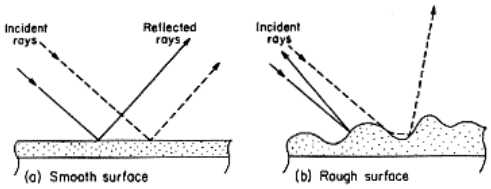
High-Efficiency Fixtures



What makes it work?



Source: Lithonia

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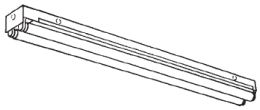
highlight to difference in delivered candela. Both use the same lamp?

Photometrics – Light Distribution

Where is the light going to end-up – Candle Power…

90.2%



93.4 %

CANDLEPOWER			
Angle	End	45	Cross
0	1510	1510	1510
5	1520	1522	1515
10	1501	1543	1579
15	1467	1559	1649
20	1422	1584	1689
25	1362	1577	1699
30	1288	1540	1639
35	1200	1459	1527
40	1095	1348	1378
45	982	1210	1218
50	854	1057	1059
55	726	897	901
60	594	747	737
65	467	590	551
70	342	428	348
75	230	263	185
80	131	128	85
85	51	35	21

Ceiling

CANDLEPOWER			
Angle	End	45	Cross
0	1067	1067	1067
5	1061	1068	1071
15	1021	1074	1102
25	942	1061	1125
35	828	1025	1127
45	685	964	1091
55	515	865	1017
65	331	739	882
75	155	571	722
85	26	359	494
95	0	348	502
105	0	306	461
115	1	225	399
125	0	174	324
135	3	135	245
145	3	88	168
155	6	48	96
165	7	14	33
175	7	5	8

What light source has 100% fixture efficiency?

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Luminaire Efficiency Rating (LER)

LER is Something new, manufacturers can volunteer to include on cut sheets.

LER = Fixture lumens X ballast factor X fixture efficiency/input watts

Example, 2-lamp (3,100 lumens per lamp) high performance kit:
LER = 2 X 3,100 lumens X 0.88 BF X .80 FE /55 input watts = **79.36**

Similar to how LED fixtures are being evaluated

Source: stvgreen

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Test Question

What does fixture efficiency mean?

A) Cost effective

B) Candle power divided by power factor

C) Low input watts

D) The percentage of rated lamp lumens that leave the luminaire

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Lighting Design Fundamentals

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IESNA Recommended Light Levels (9th edition)

Building Area and Task	fc	Comments
Auditoriums	10	Include provision for higher levels.
Banks – Tellers' Stations	50	
Barber Shops	50	
Bathrooms	30	
Building Entrances *(Active)*	5	
Cashiers	30	
Classrooms	50	See reading
Conference Rooms	30	Plus task lighting
Corridors	5	
Dance Halls	5	
Drafting *(High Contrast)*	50	
Drafting *(Low Contrast)*	100 to 1,000	
Elevators	5	
Exhibition Halls	10	Include provision for higher levels
Floodlighting – Bright Surroundings (Vertical)	5	Less for light surfaces – more for dark
Floodlighting – Dark Surroundings (Vertical)	3	Less for light surfaces – more for dark
Hospitals *(Exam Rooms)*	50	High color rendition
Hospitals *(Operating Rooms)*	300	Variable (dimming or switching)
Kitchen	50	
Laundry	30	
Lobbies	10	
Office – General	30	Plus task lighting for reading
Parking Areas – Covered	2	Lower at night

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IESNA Recommended Light Levels

Building Area and Task	fc	Comments
Parking Areas – Open	0.2	Higher for enhanced security
Reading/Writing	50	Varies with task difficulty
Restaurant – Dining	10	
Retail	50	General display
Stairways	5	
Streetlighting- Highways	0.9	Varies with traffic density
Streetlighting- Roadways	0.7	Varies with traffic/pedestrian activity
Supermarkets	50	
Warehouse	5	Inactive
Warehouse	10	Active:bulky items;large labels
Warehouse	30	Active:small items: small labels

Lighting Level Adjustment

Factor	Reduce Lighting Level by 30%	Increase Lighting Level by 30%
Reflectance of task background	Greater than 70%	Less than 70%
Speed or accuracy	Not important	Critical
Workers' age (average)	Under 40	Over 55

IESNA recommendations from the 9th Edition handbook

Refer to hand book or ready reference guide for areas not mentioned in this chart.

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Commercial & Industrial Lighting

Oregon

Table 505.5.2 – Interior Lighting Power Allowances
LIGHTING POWER DENSITY

Automotive Facility	0.79	Multifamily	0.58
Convention Center	1.16	Museum	1.04
Court House	1.08	Office	0.91
Dining: Bar Lounge/Leisure	1.19	Parking Garage	0.26
Dining: Cafeteria/Fast Food	1.34	Penitentiary	1.0
Dining: Family	1.5	Performing Arts Theater	1.46
Dormitory	1.0	Police	0.89
Exercise Center	0.92	Fire Station	0.74
Gymnasium	1.07	Post Office	0.98
Healthcare—clinic	0.89	Religious Building	1.18
Hospital	1.08	Retail[b]	1.32
Hotel	1.0	School/University	1.01
Library	1.17	Sports Arena	1.03
Manufacturing Facility	1.24	Town Hall	0.94
Motel	1.0	Transportation	0.85
Motion Picture Theater	1.18	Warehouse	0.73
		Workshop	1.2

Chapter 5 on the website – read only

http://www.cbs.state.or.us/external/bcd/programs/energy.html

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Definitions

- ***Coefficient of Utilization (CU)*** - The ratio of luminous flux that reaches the work surface to the luminous flux given off by the system's lamps. CU is a measure of the efficiency of the system in delivering lumens to the work plane. All lumens produced by the lamps in a lighting system will not reach the work plane. Some of these lumens are absorbed within the luminaires, and others are absorbed by the room surfaces (walls ceiling and floors). The fraction of the luminous flux that reaches the work plane is the CU. To find CU for a particular luminaire you must first determine Room Cavity Ratio, then apply to the reflectance's of the room (ceiling, floor, wall).
- ***Room Cavity Ratio (RCR) –*** is five times the ratio of vertical and horizontal surface area and therefore indicates the relative space proportions. Once you obtain the RCR you apply it to the reflectance charts on a luminaire cut sheet
- ***Light loss factors (LLF) –*** an adjustment to an illuminance calculation to account for actual field conditions. It accounts for differences in lamp lumen output, reflectances and transmittances of luminaire components, and room-surface reflectances between ideal lab conditions and the actual environment.

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Why is knowing what the LLF is important?

Effects Light Levels!!

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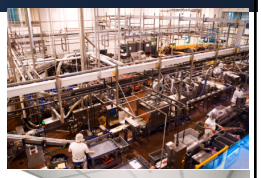
Light Loss Factors – Example



- Lumen depreciation – 0.95
- Luminaire dirt depreciation - .88
- Room surface dirt depreciation - .96
- Ballast factor .88
- 0.95 x 0.88 x 0.96 x .88 = 0.71

Recoverable light loss examples:

- Lamp lumen depreciation
- Luminaire and surface dirt
- Lamp burnout factor

Non-recoverable light loss examples:

- Temperature
- Voltage
- Ballast factor
- More…

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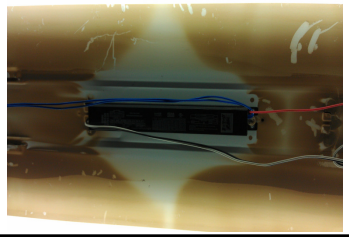
Dirt

1. **Luminaire dirt depreciation –** The amount of dirt, dust etc. that gets up inside the luminaire housing
2. **Room dirt depreciation –** The dirtier the room the less the light will reflect off walls, ceilings and floors.



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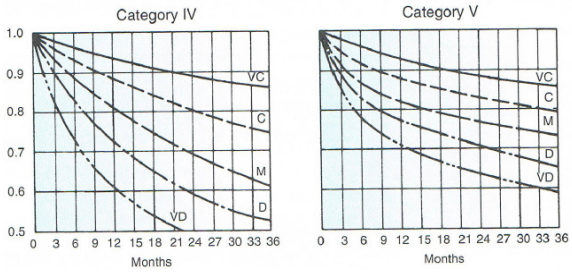
More dirt on dirt

- Very Clean- high grade offices, laboratories and clean rooms
- Clean – older offices near production areas, light assembly and inspection
- Medium – Mill offices, paper processing, light machining
- Dirty – heat treatments, high-speed printing, rubber processing
- Very Dirty – similar to dirty but luminaires within immediate area of contamination



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can use a meter to do this exercise.

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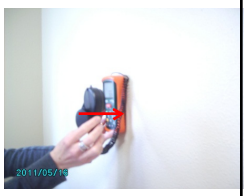
Reflectance of Surfaces

Determine reflectance in the field by doing the following:

1. Pick a spot on a wall that is around 6' above the floor that has good lighting.
2. Using your footcandle meter, get a vertical measurement on the wall facing the room.
3. At the same spot, turn the footcandle meter around so it's 12" off the wall (make sure there are no shadows) but facing the wall. Record the two numbers and divide to get the rough reflectance reading.



Example:
- Vertical measurement 6' A.F.F. facing the room= 18
- Vertical measurement 6' A.F.F. facing the wall 12" away = 8
- Reflectance = 8/18= 44%

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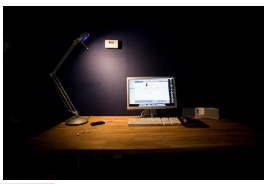
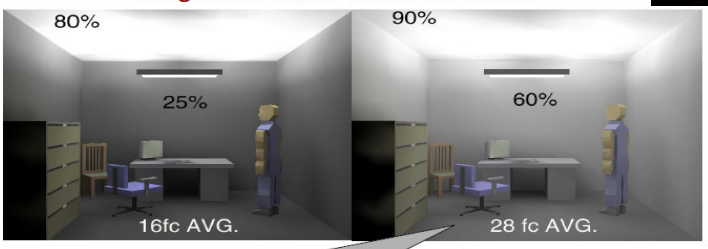
Design Considerations



Maximizing Lighting Value

Surface Color is an Energy Issue

% Light Reflectance Values of Finishes



75% more light from the same energy!

Advanced Buildings CORE PERFORMANCE

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The Lighting Design Process

- Identify the space type (office, retail warehouse etc.)
- Determine the target light levels per IESNA
- Specify a luminaire type and obtain a specification sheet
- Determine the area and ceiling height
- Determine the reflectance of the room surfaces, ceiling, wall and floor
- Determine the room cavity ratio
- Determine light loss factors
- Determine the LPD allowance for the area

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Field Notes

Field information sheet _____ Page ____ of ____
Date:
Project:
Trade Ally:
Hours of operation

	Fill in/description	QTY	Wattage	Notes
Room name				
Type of space				
Length of room				
Width of room				
Height of room				
Existing light levels- max, min and at task area				
Recommended light levels by IES				
Ceiling type				
Describe the space				
Ceiling reflectance				
Wall reflectance				
Floor reflectance				
Existing controls? Type?				
Existing Ambient Lighting				
Existing Exits				
Existing downlights				
Existing HID				
Existing Task lights				
Other lighting				
Activity				
Is there daylight present				

Description of project:

Draw example floor plan here or attach:

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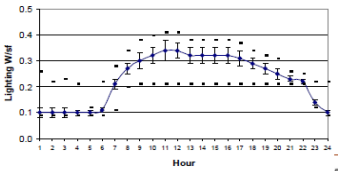
Design Considerations

Lighting Loads

- Typical Lighting Spec's
  - 1970's: 4-10 watt sq. ft.
  - 1980s – 3 watts sq. ft
  - 1990s – 1.5 watts sq. ft
  - 2005 – < 1 watt sq. ft.
- Actual use much less than 1 w/sf

Monitored Data



anced Buildings
CORE PERFORMANCE

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Lumen Method - Hand Calculation for Lighting Design "Old School"

The lumen method is based on fundamental lighting calculations. The lumen method formula is easiest to appreciate in the following form.

- Footcandles $= \frac{\text{Qty. of luminaires x lamp lumens x qty. of lamps per luminaire x CU X LLF X BF}}{\text{area}}$
- Qty of luminaires $= \frac{\text{FC x area}}{\text{qty. of lamps X lamp lumens x CU X LLF X BF}}$
- In most cases you will use the second formula to determine how many fixtures you need for the target light level.

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Lumen Method Process

- Qty of luminaires = $\frac{\text{FC x area}}{\text{qty. of lamps X lamp lumens x CU X LLF X BF}}$
- FC – Determine what is required in the space for an office (30)
- Area – measure the area, length X width = Square feet. Example 25 x 25 = 625 SF
- Qty. of lamps – number of lamps per specified luminaire. Example, 2 lamps
- Lamp lumens – number of lumens per lamp. Example 3,100
- RCR – Use formula. You'll need this first to get CU
- CU – Coefficient of Utilization NEED CUTSHEET reflectance = 80% ceiling, 50% wall, 20% floor
- LLF – light loss factors (unrecoverable) example, 0.75 (Lumen depreciation, dirt etc.)
- BF – Ballast factor, example 0.88
- Qty of luminaires = $\frac{30 \text{ x } 625 = 18{,}750}{2 \text{ X } 3{,}100 \text{ x } .80 \text{ X } .75 \text{ X } .88 = 3{,}274}$ = 5.7 or 6 fixtures

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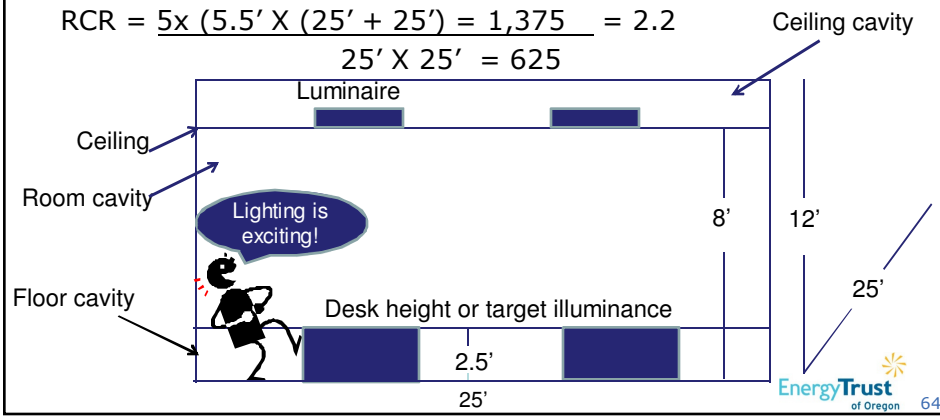
Room Cavity Ratio

Room Cavity Ratio (RCR):

RCR = $\frac{\text{5x (Room cavity height X (length + width)}}{\text{Length X width}}$

RCR = $\frac{\text{5x (5.5' X (25' + 25') = 1,375}}{\text{25' X 25' = 625}}$ = 2.2



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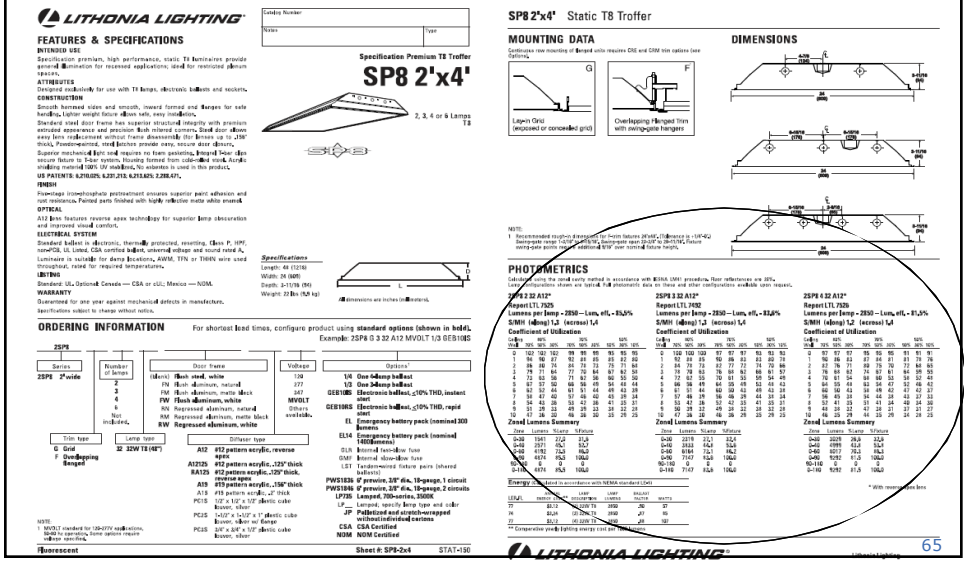
Manufacturer Cut Sheets

Lighting design using a cut sheet!



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Using RCR to Get Coefficient of Utilization

2SP8 2 32 A12*

Report LTL 7525

Lumens per lamp - 2850 – Lum. eff. - 85.5%

S/MH (along) 1.3 (across) 1.4

Spacing Criteria

Coefficient of Utilization

Ceiling	80%			70%			50%		
Wall	70%	50%	30%	70%	50%	30%	50%	30%	10%
0	102	102	102	99	99	99	95	95	95
1	94	90	87	92	88	85	85	82	80
2	86	80	74	84	78	73	75	71	68
3	79	71	64	77	70	64	67	62	58
4	73	63	56	71	62	56	60	55	50
5	67	57	50	66	56	49	54	48	44
6	62	52	44	61	51	44	49	43	39
7	58	47	40	57	46	40	45	39	34
8	54	43	36	53	42	36	41	35	31
9	51	39	33	49	39	33	38	32	28
10	47	36	30	46	36	30	35	29	25

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Compare

Existing

- 30, 4-lamp T12, 1.97 watts per S.F. 70 F.C.

In this example

One for one 4-lamp T12 to 4-lamp T8 NBF

- 4,920 kWh saved, 34%, 1.32 watts per S.F. 79 F.C.

One for one 4-lamp T12 to 2-lamp T8 NBF

- 8,977 kWh saved, 66%, 0.7 watts per S.F. 45 F.C

One for one 4-lamp T12 to 2-lamp T8 LBF

- 9,965 kWh saved, 74%, 0.5 watts per S.F. 40 F.C

Redesign to the example of 20 fixtures

- 10,487 kWh saved, 78%, 0.4 watts per S.F. 30 F.C

All above do not include controls. Controls will increase kWh savings

What will you be doing when T12 incentives are reduced or removed?

Remember, when you decrease fixture counts, you decrease ballast and lamp quantities which decreases????

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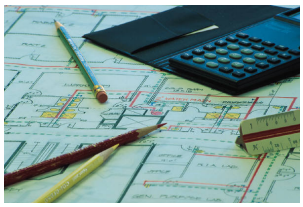
The old days, LPD method



- Square feet of space – 2,500
- LPD allowance .91 = 2,275 watts
- 2-lamp T8 with normal ballast factor = 58 input watts
- 2,275/58 = 39 fixtures to meet LPD
- You would need to do a lighting calculation to determine light levels

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Lesson Learned

There are multiple factors that go into determining appropriate light levels.

To start moving beyond 1 for 1, it is important to understand design principals!

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Test Question

What are the main components to achieving <u>maximum</u> kWh savings?

A) Design to meet or beat LPD

B) Design per IES recommendations

C) Use lighting controls in all appropriate applications

D) All of the above

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Lighting Software and Design Considerations

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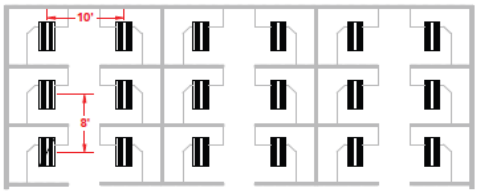
Design Templates

LAYOUT OPTIONS

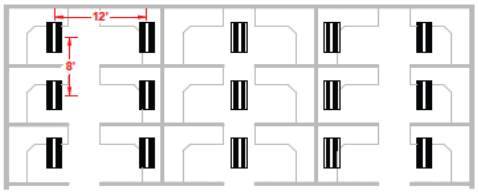
Open Office 2-Lamp High Performance Lensed | 8' x 10' Spacing



INSTALLATION SPECS

Number of Luminaires:
18
Luminaire Spacing:
8' x 10' on center
Mounting Condition:
Recessed
Average Illumination:
~36 footcandles
Watts/sq. ft.:
0.65

Open Office 2-Lamp High Performance Lensed | 8' x 12' Spacing



INSTALLATION SPECS

Number of Luminaires:
15
Luminaire Spacing:
8' x 12' on center
Mounting Condition:
Recessed
Average Illumination:
~30 footcandles
Watts/sq. ft.:
0.54

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Lighting Software Demonstration

Project

Title
Description
Number
Company
Designer

Room

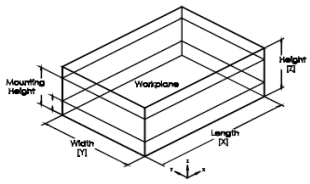
Length	[X]	25	ft
Width	[Y]	25	ft
Height	[Z]	8	ft
RCR		2.20	
Ceiling		80	%
Walls		50	%
Floor		30	%
Workplane Height		2.5	ft

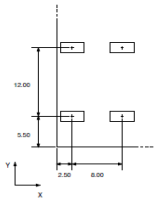
Luminaire

Mounting Height		8	ft
Catalog Number		2SP8 2 32 A12	
Manufacturer		Lithonia Lighting	
IES File Name		2SP8_2_32_A12.ies	
Lamp Description		TWO 32-WATT LINEAR FLUORESCENT T8, HORIZONTAL POS.	
Number of Lamps		2	
Lamp Lumens		3100	
Light Loss Factor		.75	
Coefficient of Utilization		0.77	

Output

Illuminance		34	fc
Number of Luminaires		6	
Number of Columns	[X]	3	
Number of Rows	[Y]	2	
Column Spacing	[X]	8.00	ft
Row Spacing	[Y]	12.00	ft
Column Start	[X]	2.50	ft
Row Start	[Y]	5.50	ft
Power Density		0.49	W/ft²





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Lighting Layout Software

Overview of Lighting Software Features

	Allows import of any IES Files	Provides IESNA recommended footcandles	Program provides summary page with required data* (when established)	Direct calculation and printout of point-by-points
AGI 32	X	X	X	X
LightCALC			X	
LightPRO	X	X	X	X
Lumen Micro	X	X	X	X
Luxicon	X	X	X	X
Visual Basic	X		X	
Visual Pro	X	X	X	X

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Lesson Learned

Utilize the tools and resources available to you! If you can't do it, contact your local distributor or lighting representative

Using lighting design software removes guesswork or estimation.

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Real Life Example

Office

Installed
task lights, using natural daylight. No overhead lights on.

Replaced
fluorescent troffers with new fixtures & installed new task lights…fixture count 1 for 1, but still "re-design".

Source: sourec.com

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Real Life Example

Museum

Redesign of lighting system using new T5HO fixtures.

Replaced metal halide…not 1 for 1!

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Improve Lighting Perception

- Improving the color rendering index (85%)
- Higher kelvin temperature, whiter light (3,000K to 5,000K)
- Lighting more surfaces in the room, ceiling and walls
- Light colored paint, carpet or ceiling tiles

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Human Perception

CRI=90 CRI=70 CRI=50

- Higher CRI lamps improve visual perception
- Using this theory, some professional organizations and manufacturers are lowering light levels to save energy
- Case studies and research indicate that humans perceive higher CRI and whiter light as brighter light. Source: noburnlightingandbath.com

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Test Question

White paint can save energy?

A) True

B) False

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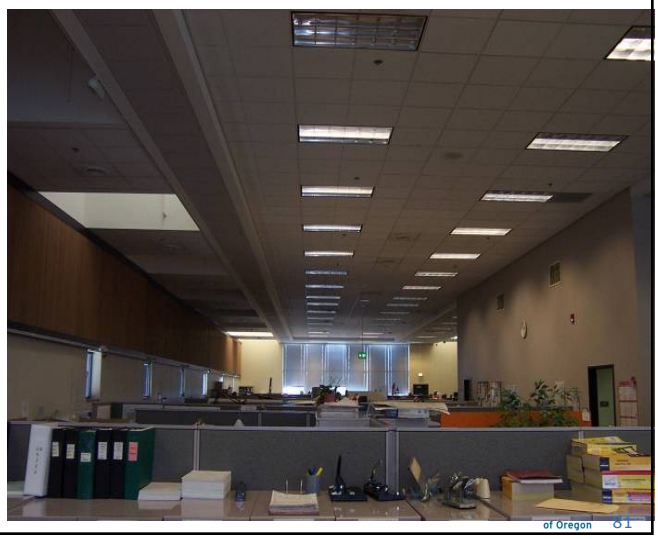
Case Studies

Before…

- 2x4 Parabolics (3) lamp T12, 34W
- 9.5' Ceiling
- 8' x 10' Spacing
- 2.2w./sq.ft.
- 20 FC Average



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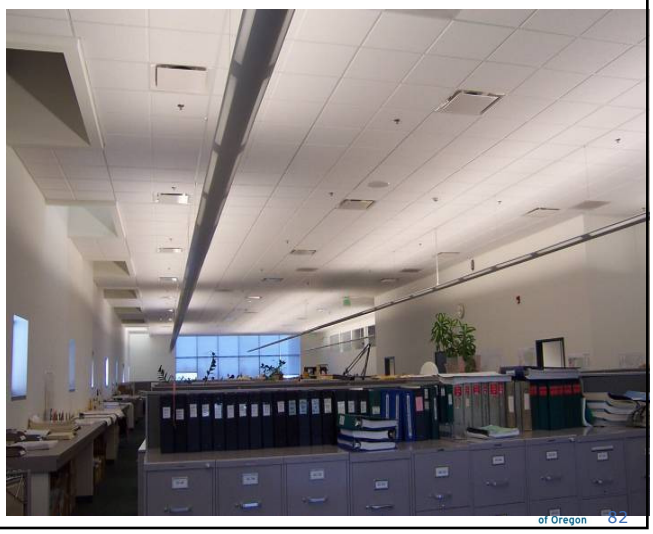
Case Studies

After

- Suspended linear T5HO
- 9.5' Ceiling
- 0.8w/sq ft
- 38 FC Average



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Lesson Learned

Consider meeting IES light levels meeting or beating LPD and using controls in each and every space when making lighting decisions.

There is no "one size fits all" in lighting!!

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Real-world ideas and award winning products

(from LED's to …)

Section 3 table of contents

- New products
- Exterior lighting
- Lighting controls
- Education

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Commercial & Industrial Lighting

Innovation Award – Recessed LED

LED Troffer

A 59 watt 2x2 LED deep regressed lensed troffer for vertical and horizontal illumination producing 3549 lumens at 62 lpw and 80 CRI.

How does this compare to a standard 2X2?

A 62 watt 2x2 standard lensed troffer for vertical and horizontal illumination producing 5400 lumens at 87 lpw and 80+ CRI.

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Source: Lightner

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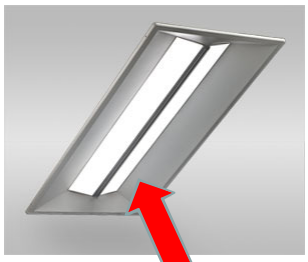
LED panels, troffers



CR24				S	
Product Series & Size	**Lumen Output**	**Color Temperature**	**Voltage**	**Control**	**Options**
CR24 2'x4'	**22L** 22W 2200 Lumen - 100 LPW **40L** 44W 4000 Lumen - 90 LPW **40L HE** 36W 4000 Lumen - 110 LPW **50L** 50W 5000 Lumen - 100 LPW	**35K** 3500 Kelvin **40K** 4000 Kelvin	**Blank** 120-277 Volt (Standard)	**S** Step Dimming to 50% **10V** 0-10V Dimming to 5%*	**CP** Chicago Plenum* **EB** Emergency Backup*

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Source - Cree

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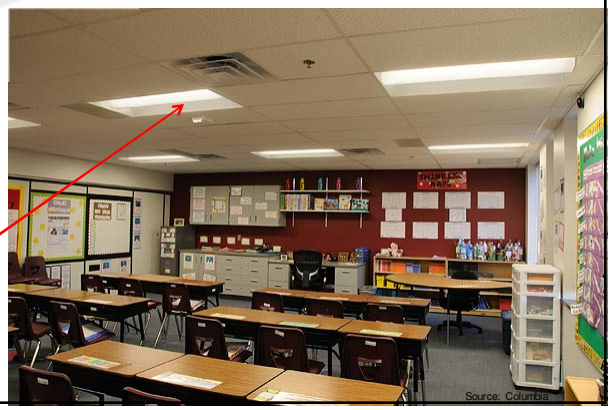
Highest Efficiency "basket" fixture…

- Unprecedented fixture efficiencies
- Up to 95% efficient using T8
- Over 100% efficient in T5 lamping
- 1, 2, 3-lamp cross sections
- T8, T5, T5HO and twin tube lamping
- Three fixture sizes

What is the fixture spacing in this picture?



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Innovation Award "High-bay style" LED

IES Progress Report Selection from Exceline

Warehouse

Replaced 400 Watt Metal Halide with new 288 Watt LED "bay lighters".

Accessorize: Available with IP65 hose down rating, built-in occupancy sensor and photocell!

Source: Lightolier/Exceline

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Ceramic MH

IES Progress Report Selection from Guth

CERAMIC MH RETROFIT KIT - REDUCE ENERGY 50% - FREE TRIAL

Use Existing Pulse Rated Socket - Up to 3X Lamp Life - UL Listed Ballast

FEATURES
- 110 to 120 Lumens per watt
- Replaces up to 400W HID
- 24-30,000 hour lamp life
- 10-15% lamp lumen depreciation
- 70-90 CRI white light
- Up to -22°F (-30°F) starting
- 40-70% less cost than LED
- Thermally protected ballast

BENEFITS
- Reduce energy up to 50%
- Universal application
- Maintenance reduction
- Higher maintained lumens
- Provides white light visibility
- Use anywhere
- 1 to 3 year payback
- Cycles lamp if overheated

APPLICATIONS
- Street lighting
- Parking areas
- Walpacks
- Post-top fixtures
- Decorative fixtures
- Industrial lighting
- Commercial fixtures
- Recessed HID

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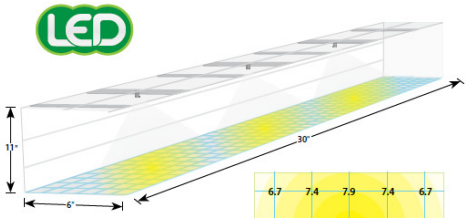
LED Retrofit or New for vaportites..

Long LED life, up to 50,000 hrs
- Very low energy use – less than 20 watts per fixture
- Ideal for retrofit of existing incandescent fixtures
- Available in frosted glass globe or acrylic flat lens that delivers up to 3x the light levels of incandescent
- Units are listed to UL1598 for use in wet locations

FOOTCANDLE PERFORMANCE COMPARISON

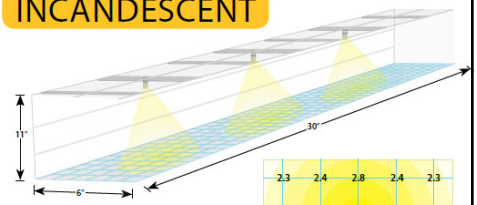
Vaportite Fixture	Optics	Min	Max	Average	Ave/Min	Max/Min
VLED15 (LED)	Flat Acrylic Lens	6.5	8.9	7.0	1.68	2.12
NVx15G (Incandescent)	Frosted Glass Globe	2.3	3.7	2.4	1.72	2.69

LED



- Three times the light levels
- 1/2th the total wattage
- About 50 times the rated life
- Test #3637

INCANDESCENT



- 1/3rd the light levels
- 7 times the wattage
- A fraction of the rated life
- Test #BAL6682

Source:Hubbell

BPA has 40 LP/watt and must save 50% or more.

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Less 10 watt LED's…
Small watts = REAL SAVINGS!!

40W Incandescent lamps in hotel wall sconces were replaced with 7W LED @ installed cost of $25 each.

With incentive, payback was 1 year and $612 per year energy savings!

75W MR16 lamps in fast food restaurant were replaced with 9W LED @ installed cost of $35 each.

With incentive, payback was 1.4 years and $893 per year energy savings! (Not to mention HVAC savings)

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Source: UniverLED & RPI

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Less 10 watt LED's…
Small watts = REAL SAVINGS!!

BEFORE
25 Watts per lamp

AFTER
3 Watts per lamp

CREE LED screw in lamp

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Give link to new LED fixtures.

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Lesson Learned

Think "outside" the box! There are innovative new products on the market

An opportunity to sell more than just lamps & ballasts!

Who doesn't like the latest & greatest? (hint, think cell phones)

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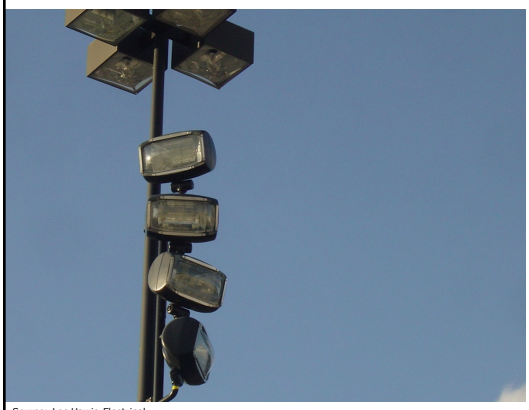

Source: Lee Harris Electrical

Exterior Lighting

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Early Test Question

What is the purpose of exterior lighting?

A) Make customers aware the facility is open and advertise to people passing.

B) Customers feel safe when parking and walking in & out of facility.

C) All objects (including faces & cars) are recognizable to cameras and people.

D) All of the above.

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Several factors to consider & review…..

- Appearance of light levels
- Security concerns
- Driving conditions
- Achieving energy savings, while not affecting everyday business…

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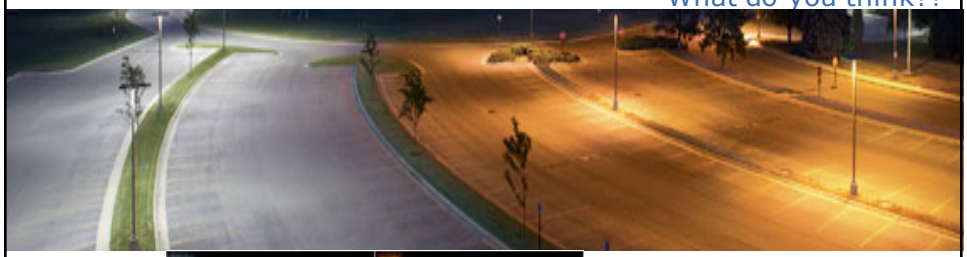
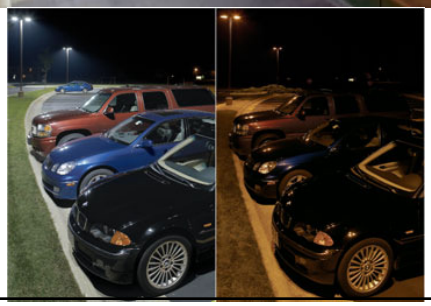
S/P Ratio Example (scotopic/photopic)

What do you think??





Beta Lighting did these test cases to show client.

(250W HPS vs 75W LED)

Source: Beta/Ruud

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T5HO Fluorescent

T5HO is getting a new venue with outdoor lighting. With all the benefits that these lamps bring (including high lumen package), it is more attractive for an exterior system.

Benefits

- Long Life, up to 40,000 + hours
- Better lumen maintenance (5% compared to 30% for HID)
- Higher CRI than HID
- Lower operating cost

Drawbacks

- Larger fixture housing
- Temperature sensitive (can affect light output)
- Aesthetics can be an issue

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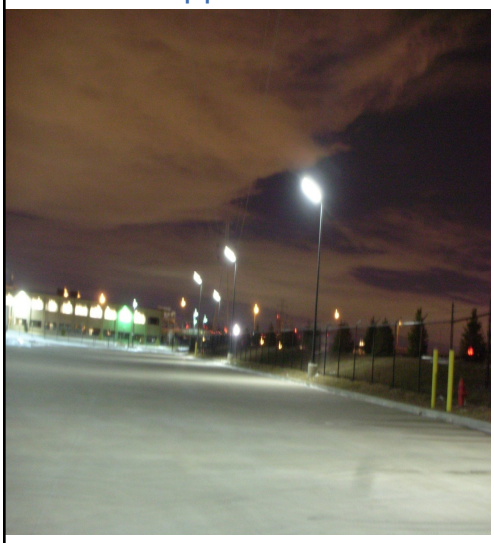
Real life application



Large Parking Lot with T5HO fixtures & LED wallpacks

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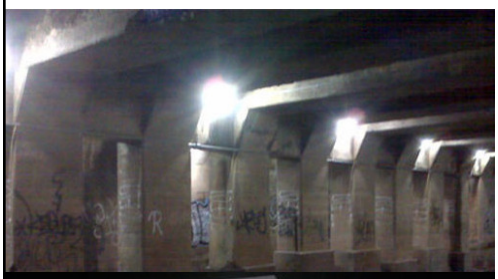
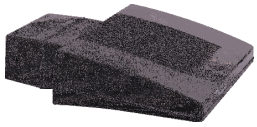
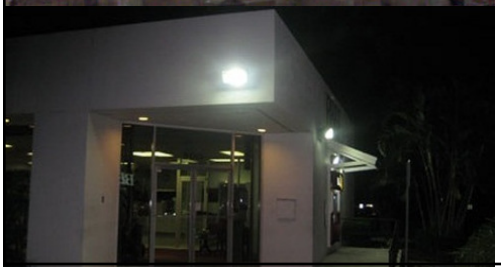
LED Wallpacks

More affordable and many available on approved lists!
Consider the areas where its not just energy & maintenance savings….





These fixtures are in a tunnel where safety is the main issue….Does the customer want these lights to only last 25,000 hours?



These fixtures are outside of a bank with walk-up ATM….does the customer care if these light levels drop 30% in the first year?

Source: aledlights

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Lesson Learned

There are new lighting sources for exterior lighting, not just HID.

There are many critical factors that go into exterior lighting…not just energy savings.

- Safety & visual comfort
- Security *(including ambient light for cameras)*
- Energy codes
- Light trespass/dark sky

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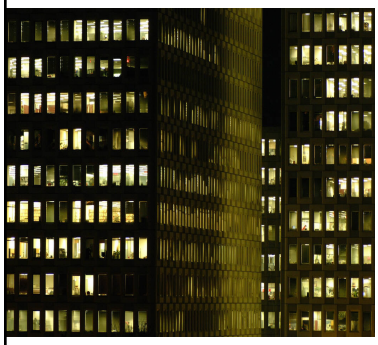

Controls & Daylighting

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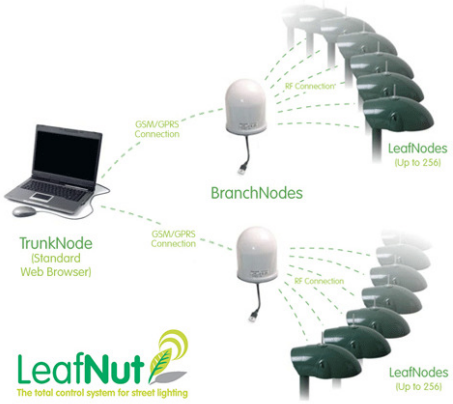
Control the lights…



Ideal Application: Mall parking lot. Stores close at 10 pm, employees gone by midnight… turn half lights off from 1 to 4 am or dim to 50%...

One of several systems on the market…

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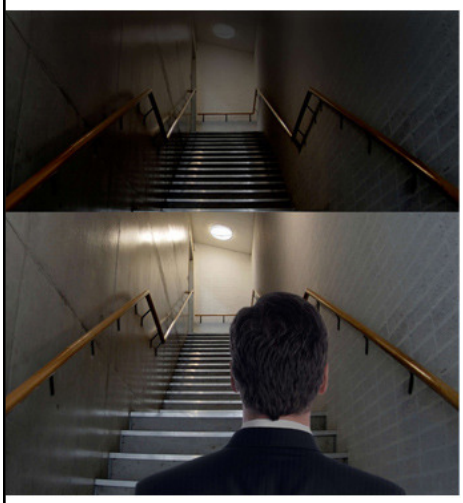
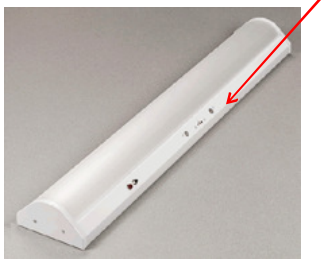
Commercial & Industrial Lighting

Controlled stairwell fixtures for energy savings



Built in occupancy sensor & bi-level or full on/off switching.



NFPA 101 section 7.8.1.2.2 says: *Automatic, motion sensor type lighting switches shall be permitted within the means of egress, provided that the switch controllers are equipped for fail-safe operation, the illumination timers are set for a minimum of 15 minute duration, and the motion sensor is activated by any occupant movement in the area served by the lighting units.*

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Combination Occ Sensor and Photo Cell

The photocell sees a combination of daylight and electric light. The system continuously adjusts the electric light to maintain the set light level.

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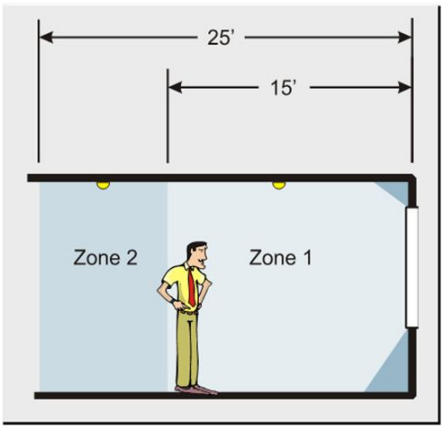
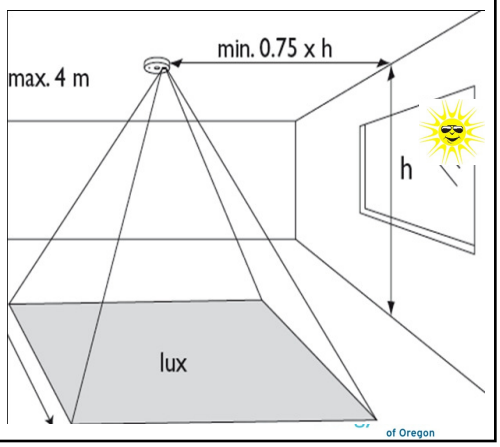
Sidelighted Daylight Zone

Daylight zone is defined by the ASHRAE/IES 90.1-2010 energy standard as "the floor area substantially illuminated by Daylighting"





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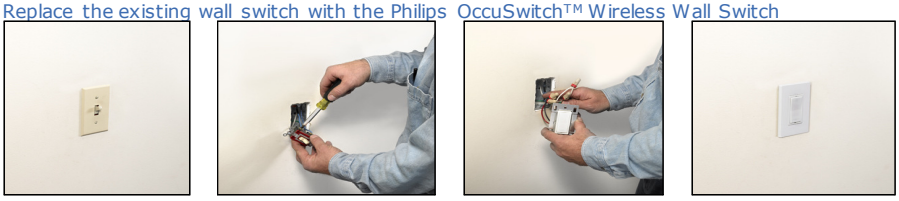
OccuSwitch™ Wireless Controls

Easy System Set-Up

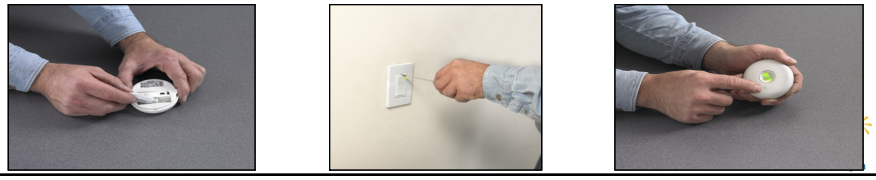
Step 1:

Replace the existing wall switch with the Philips OccuSwitch™ Wireless Wall Switch



Step 2:

Insert the battery, then press the link button on the switch and then the link button on the sensor to setup the wireless connection



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OccuSwitch™ Wireless Controls

Easy System Set-Up

Step 3:

Mount the sensor to the ceiling

Adjust coverage with retractable 360° rotating shield

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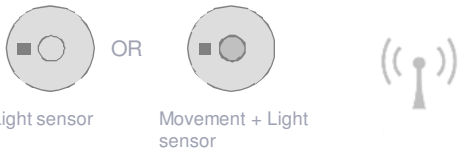
OccuSwitch™ Wireless Controls

Daylight Sensor for dimming

- Easy to install, "retrofitable" system for daylight harvesting system
- The Wireless Daylight Sensor communicates with Advances Mark 10 TRIAC wireless wall dimmer to balance the right mix of natural and electric light.
- No extra control wiring, the full range of continuous dimming delivers occupant comfort and saves energy.

Dimming through the power leads



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Daylight Harvesting…

Opportunity is everywhere!!

These T5HO lights were on all day!
Hours: 7:00 to 6:30PM

This is a skylight!

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Daylight Harvesting…

Opportunity is everywhere!!

These lights are on all day!
Hours: 24-7

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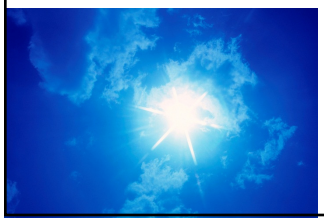
Lesson"s" Learned

Lighting controls does not = occupancy sensors only

Control panels and multi-level switching is an excellent option!



Daylight harvesting can be a simple addition to any project

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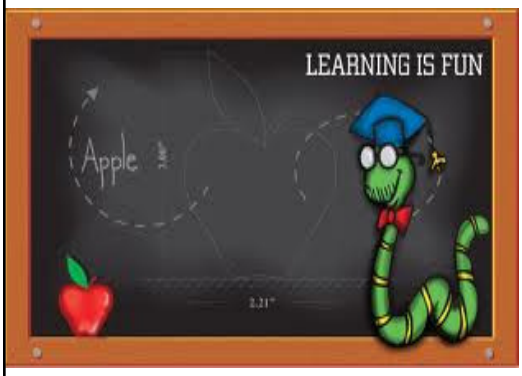

Educational Opportunities

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Illuminating Engineering Society of North America (IESNA)

- Become a member
- Local educational luncheons
- Local classes each year
- Free on-line classes
- Fee based on-line classes
- Free downloads including Advanced Energy Guidelines
- Webinars
- Book store
- www.ies.org

Illuminating ENGINEERING SOCIETY

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More sites for on line classes

- www.aboutlightingcontrols.org - lighting controls
- www.lightolier.com/resources/edu_lessons.jsp basic lighting knowledge
- www.advance.philips.com/university ballast components, operation, troubleshooting, new technologies
- http://www.lrc.rpi.edu/education/ lighting terminology, lighting technology, residential lighting
- http://www.algonline.org/ detailed design applications, case studies and more

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