

Glowing Reviews: The Best in Energy Efficient Commercial Lighting

May 2017

Meet Your Presenters:

Mike Carter



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- ▶ Lighting Fundamentals
- ▶ Replacement Alternatives
 - Incandescent A-Lamp
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 - MR16 Reflector Lamp
 - Recessed Downlights
 - Directional PAR Lamps
 - High-Bay Lighting
- ▶ Outdoor Lighting
- ▶ Lighting Controls



Source: Ephesus Lighting Inc.

Lighting Fundamentals

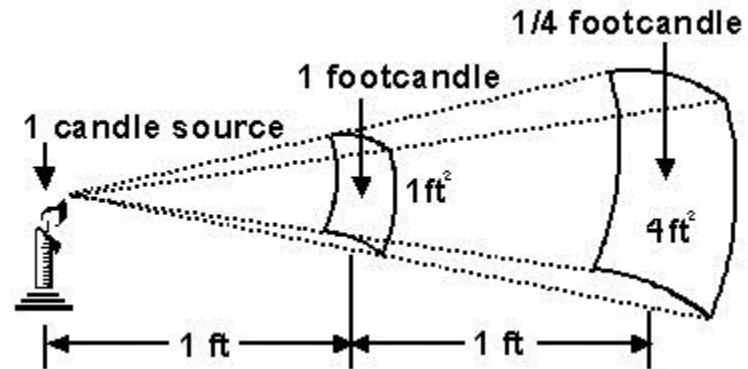
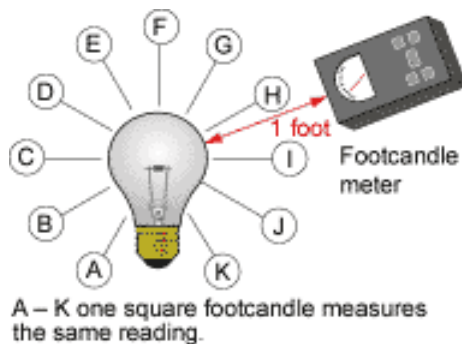
- ▶ **Lumens**—a measure of the perceived power of light.



- Constant output regardless of distance from source

- ▶ **Foot-candle**—one lumen of light distributed over a square foot area.

- Depends on the distance from the light source
- Does not hold for focused fixtures like flood lamps
- Can be measured using a light meter



Lighting Fundamentals

Color Rendering Index (CRI)

- ▶ The measurement of a light source's ability to render colors in the same way sunlight does.
 - CRI describes to what degree the light spectrum source is *filled out*.



65CRI

92CRI

Lighting Fundamentals

Color Correlated Temperature (CCT)

- ▶ The apparent/ perceived color of a light source expressed in degrees Kelvin (K).
 - <3,200K is *visually warm* or red/yellow (good for reading)
 - Incandescent ~2,800K
 - >4,000K is *visually cool* or blue (good for inspection)
 - Sunlight ~5,500K



Source: PHOTOWORKSHOP.COM

Lighting Fundamentals

Switching Impact

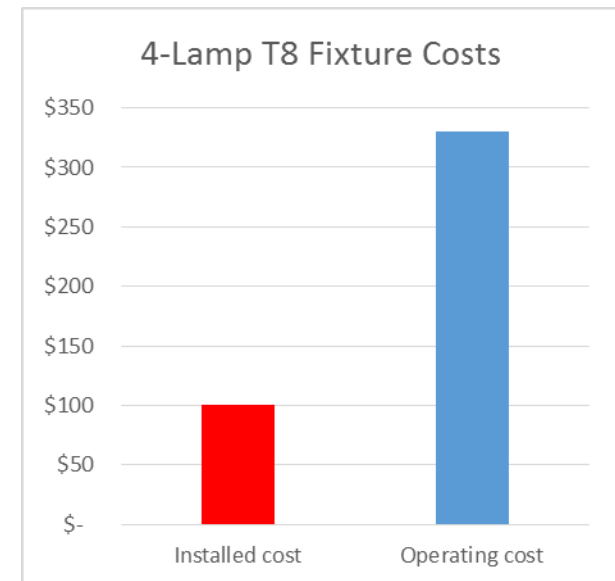
- ▶ Lights do not consume more energy when they are first turned on.
 - Includes high-intensity discharge (HID) lighting.



Source: DOE

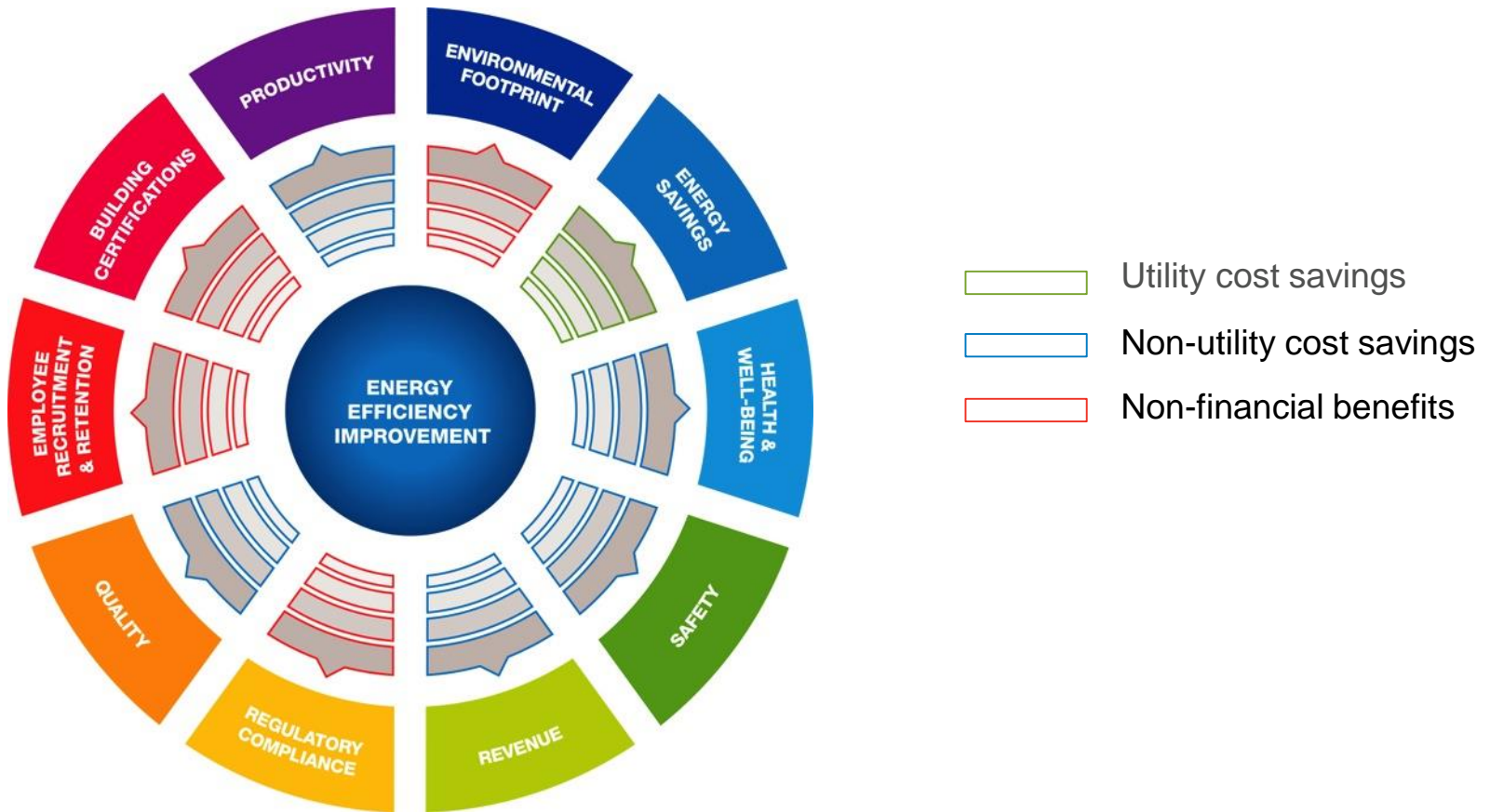
Lighting Lifecycle Costs

- ▶ Pay the price for improved energy efficiency!
 - The operating cost over the lifetime of a light fixture can far exceed the original purchase price.



Lighting Fundamentals

Energy Efficiency Benefits Wheel



Lighting Fundamentals

Two Types of LEDs

- ▶ DC LEDs
- ▶ AC Circuit LEDs
 - 20V to 64V per LED
 - Fewer components
 - Lower costs
 - Increased reliability
 - Thinner form factor
 - Flicker can be noticeable
 - Dimming is more challenging
 - Best applications
 - Low voltage track lighting, cove lighting, and landscape lighting
 - Line voltage fixture space-constrained applications
 - Street lighting
 - Recessed lighting
 - Cove lighting



7 Watt MR16

AC Solution



Source: Lynk Labs, Inc.

Lighting Fundamentals

Heat Loss in LEDs

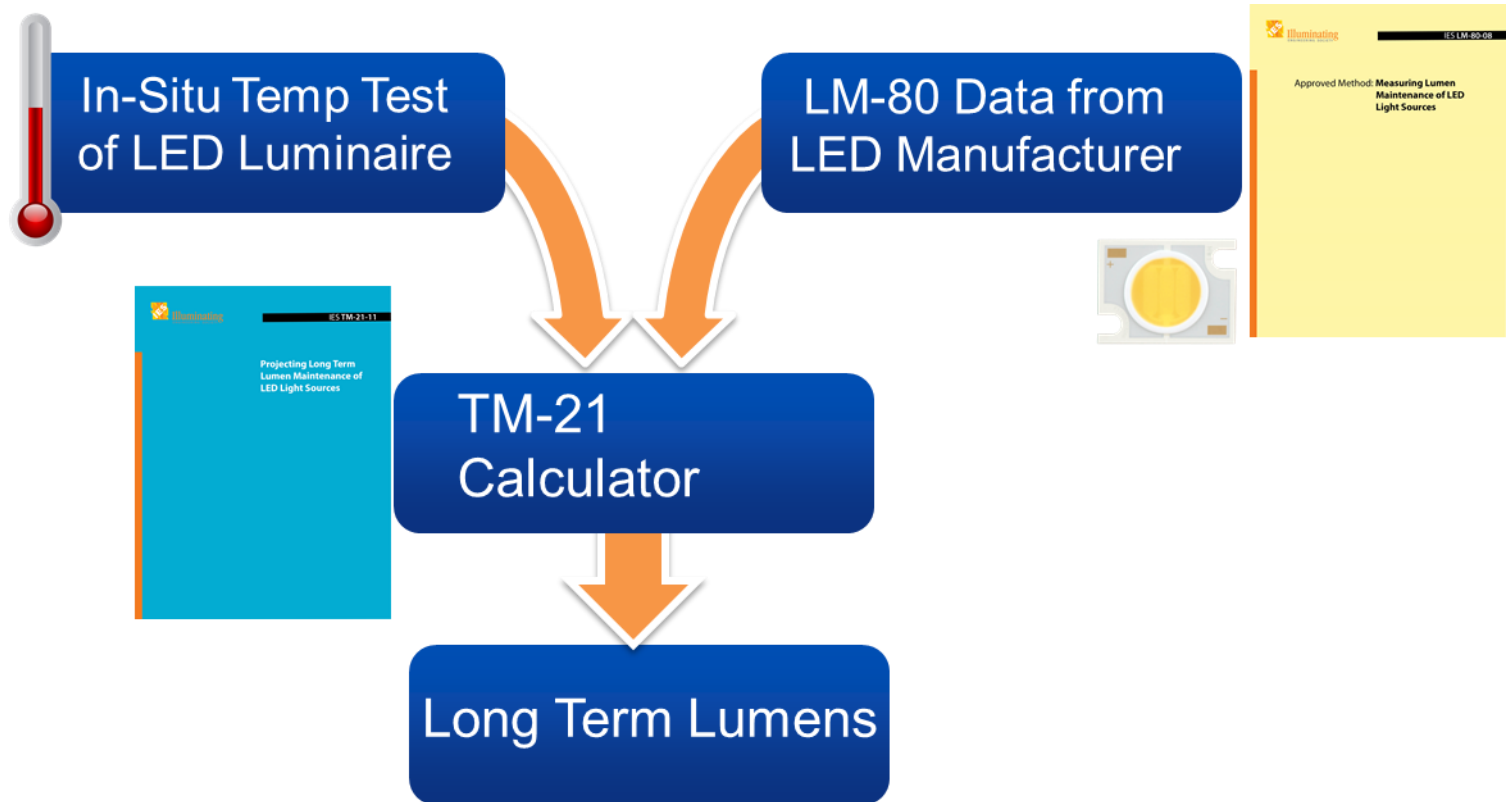
- Through conduction, not radiation
- Heat is the enemy of performance for LEDs
 - Tested at 25°C (77°F) ambient but operated at 60°C (140°F) junction temperature
 - Typically 110°F maximum ambient temperature
 - Enhanced by cold temperatures
 - Excessive heat and cold diminish fluorescent performance



Source: ENERGY STAR

Lighting Fundamentals

Determination of Rated Life



Lighting Fundamentals

Comparison with Traditional Lighting

Type	Rated Life, hours	Lumens per Watt	CRI	Lumen Maintenance
LED	50,000	35–200	70–90	95–98%*
Incandescent	750–1,500	10–17	100	95%
Fluorescent	10,000–20,000	60–100	80–86	90–95%

*At 40% fluorescent rated life; 70% to 90% at 50,000 hours

- ▶ DOE Commercially Available LED Product Evaluation and Reporting [\(CALiPER\) program](#) benchmarks LED products

Incandescent A-Lamp Replacement

Brand Name	Wattage	Lumens	CCT	Life (Hrs)
LEDzworld Professional LED Bulb CTA	6.5W	250	2500K	35,000
GE Energy Smart™ LED	9W	450	3700K	25,000
Philips AmbientLED™	12.5W	800	2700K	25,000
Sylvania LED A-Line	12W	810	2700K	25,000



Source: Archipelago
Lighting Candelabra



Source: Stack
Lighting



Sengled Pulse
Flex

Poll Question

- ▶ Which lighting metric changes with distance from the lamp?
 - a) Lumens
 - b) Foot-candles
 - c) CRI
 - d) CCT

Linear Fluorescent Replacement

Energy Conservation Program (ECP)

- ▶ 2014 Lamp Rule for Fluorescent Lamps
 - Effectively eliminates full-wattage T8 lamps
 - Effective January 26, 2018

CALiPER Evaluation

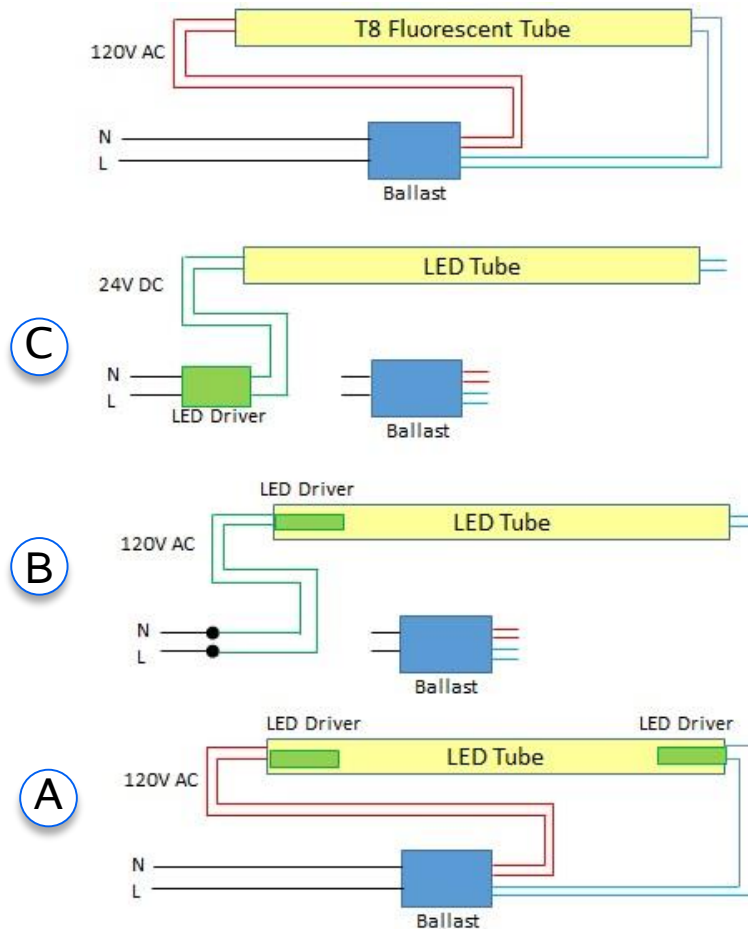
- ▶ June 2016 Snapshot Report
 - Average lumen output of 2,100 lumens
 - Equal lumens/watt output as bare fluorescent
 - Narrow LED light distribution
 - Only 1% have 90+CRI
 - Roughly \$10 to \$18 per LED lamp
 - Purpose-built LED troffers are more efficient



Source: Energy Focus

Linear Fluorescent Replacement

Replacing Fluorescent Tubes with LED Tubes

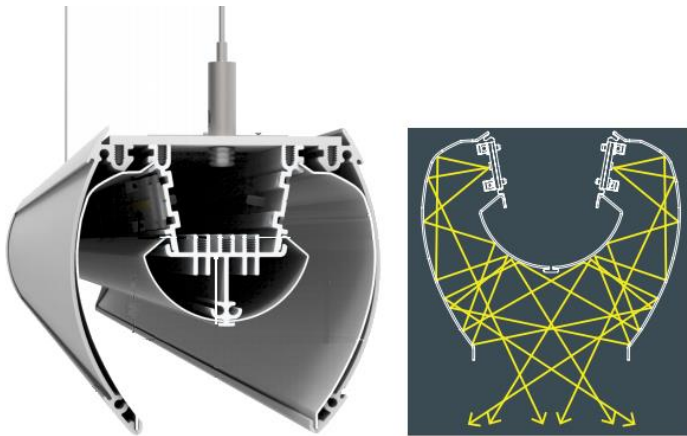


Source: Luxul La Lune

Linear Fluorescent Replacement

Purpose-Built Linear LED Troffers

- ▶ CALiPER January 2016 Snapshot Troffers report
 - Mean efficacy is 102 lpw
 - 89% have a CRI in the 80s
 - Lumen output matches fluorescent troffers



Metalumen Manufacturing Inc.



Source: GE by Current



Source: Axis Lighting

Linear Fluorescent Replacement

LED Retrofit Kits

- ▶ Volumetric
 - Leviton Zipline™ LED Platinum Series
 - 2x4 models offer 5700 lumens at 60 watts
 - LG Performance Troffer
 - 2x4 model offers 3200 lumens at 32 watts with built-in Zigbee wireless control
 - Deco Lighting Game Over (G-O) LED Retrofit Kit
 - 2x4 model offers 4200 lumens at 35 watts with built-in Bluetooth Smart wireless control



Source: Leviton Lighting & Energy Solutions



Source: LG

Linear Fluorescent Replacement

LED Retrofit Kits

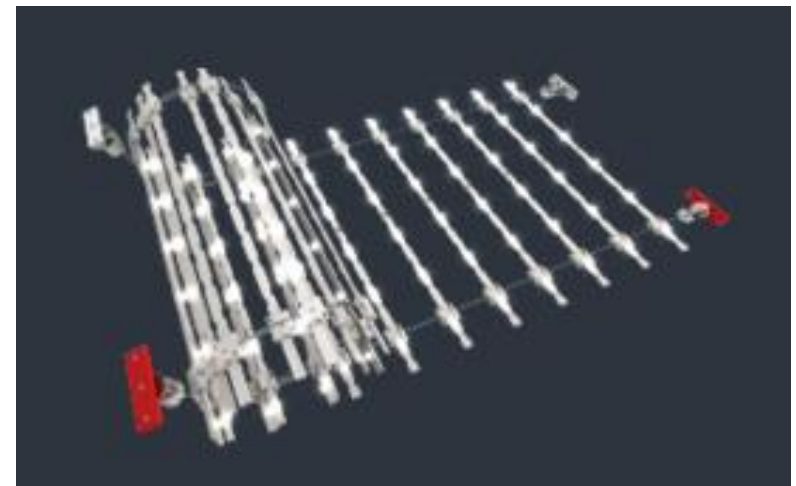
- ▶ Strips
 - LED Living Technology
 - CLARIS LED Retrofit Kits
 - 3700 lumens@24 w and 5000K
 - 6800 lumens@45 w and 5000K



Source: LED Living Technology

Signage Backlighting

- ▶ TLS International Tension LED System
 - Connectors mounted on steel cables
 - LED boards
 - Mechanical anchors
 - Cable tensioners



Source: TLS Tension LED



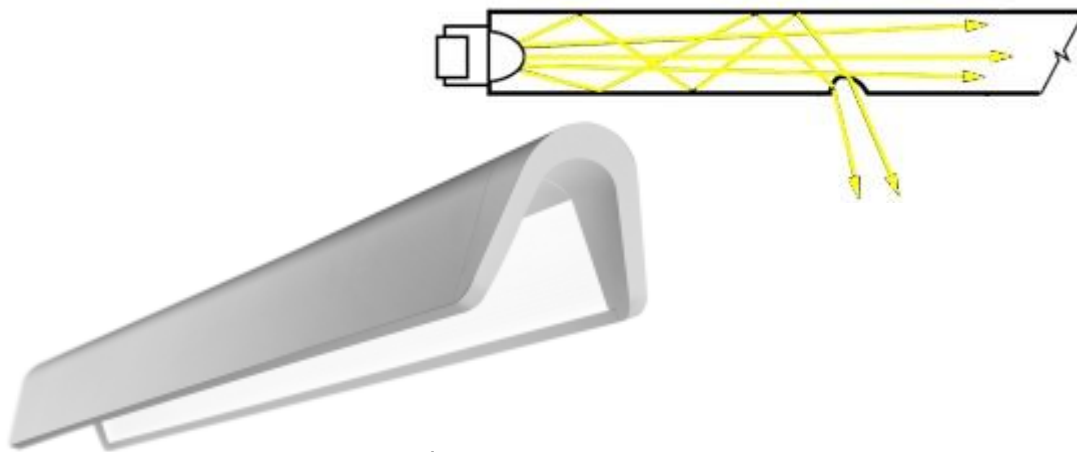
Linear Fluorescent Replacement

Light Guide Products

- ▶ GE Edge Lighting/Lumination
- ▶ Philips CoreView
- ▶ Cooper Lighting's Metalux Encounter
 - 8400 lumens @ 109 watts, 85 CRI



Source: GE Lighting



Source: Fluxwerx



Source: Cooper Lighting

Linear Fluorescent Replacement

Light Guide Products

- ▶ GE Lumination™ LED Luminaires EL Series
- ▶ Cree LN Series
- ▶ Cooper Lighting



Source: GE Lighting



©2013 Cree, Inc.

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Source: Cooper Lighting

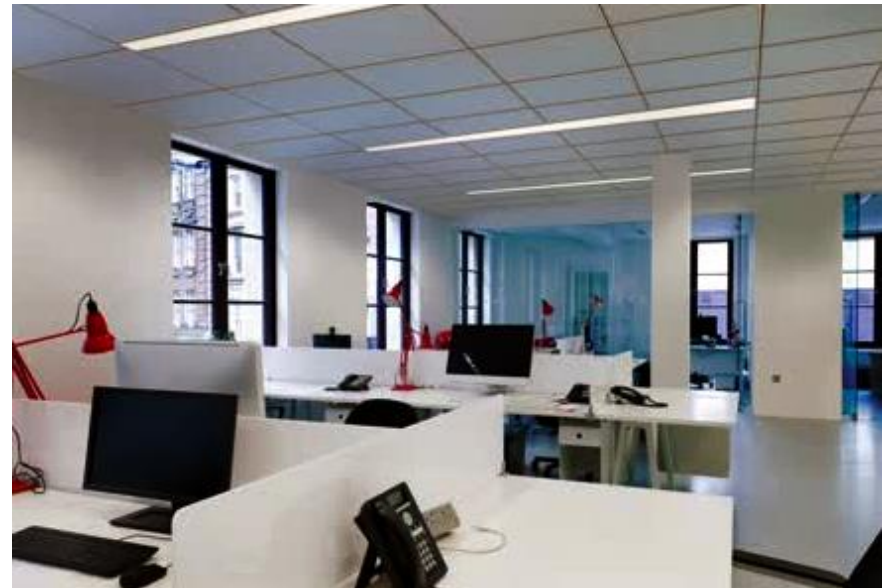


Linear Fluorescent Replacement

Recessed or Zero Plenum Lighting



Source: JLC TECH, T-BAR LED Smartlight™



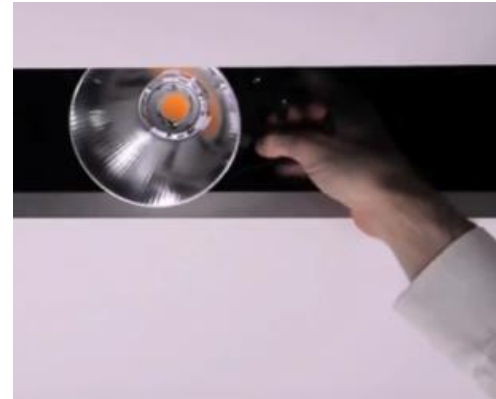
XAL USA/Armstrong's Leno Zero Plenum

Linear Fluorescent Replacement

Recessed or Zero Plenum Lighting



Tech Lighting's ELEMENT Merge



Beta Calco, Inc. RAIL-LITE™



Minebea Co., LTD. SALIOT

Linear Fluorescent Replacement

Light Guide Products

- ▶ Acuity Brands Lighting RUBIK™
 - RUBIK Grayscale
 - RUBIK Color Accent



Source: Acuity Brands Rubik

OLED Products

- ▶ Acuity Brands/Peerless Lighting Olessence™
 - Duet SSL™ Technology
 - Combination of OLED (700 lumens) and LED (up to 6,000 lumens) light sources



Source: Acuity Olessence

Linear Fluorescent Replacement

Daylighting Adjunct

- ▶ Acuity Brands Lighting LightFlex™ CCT
 - Tubular prismatic daylighting solution
 - Automatically color-shifts cool daylight CCTs to 3600K
 - 3,000 lumens from LEDs



UL Listing Issues

- ▶ None if retrofit kit has UL classified label
 - Luminaire Conversions, Retrofit (IEUQ)
- ▶ Check with Authority Having Jurisdiction (AHJ)



Source: Acuity LightFlex



MR16 Reflector Lamp Replacement

CALiPER Test Results*

- ▶ 27 different 12V MR16 LED products in 2014
- ▶ 276 LED MR16 lamps in 2016 Snapshot Report
 - The popular 12V products have less lumen output than halogen lighting
 - Mean efficacy of 61 lumens per watt
 - CBCP is still poor
 - Some 50W “equivalent” products
 - >500 lumens



*CALiPER Application Summary Report 22:
LED MR16 Lamps (June 2014)

Source: Sora VIVID Mosaic



Source: Verbatim Americas

Recessed Downlights

LED Performance

- ▶ LED downlights average 68 lumens per watt and 1,185 lumens*
 - 90+ CRI is not uncommon
- ▶ Directional nature of LEDs is an advantage
- ▶ Removing heat from the can is a real challenge for R-CFLs and LEDs

*CALiPER Snapshot Report: Downlights (March 2016)



Source: DMF Lighting OneFrame



Source: Tech Lighting ELEMENT Reflections

Recessed Downlights

LED Performance

- ▶ Cree LED Lighting LR6 6" LED Recessed Downlight at 12 watts and 650 lumens costs around \$80
- ▶ Cooper 3.5" P3LED offers 1000 lumens at 20 watts (50 lpw)



Source: Juno Lighting Group Indy™
ChromaControl



Source: Delray Lighting Kone 3



Source: Green Creative

Poll Question

- ▶ Which of the following is NOT an advantage for LEDs?
 - a) Rated life
 - b) Vibration
 - c) Hot ambient temperatures
 - d) Frequent switching
 - e) Energy consumption

Directional PAR Lamps

CALiPER Test Results

- ▶ 38 LED PAR38 and 9 LED PAR30 reflector lamp products
 - Much better than halogen bulbs
 - Best LED PAR38 are competitive with CMH
 - Can flicker when dimmed



Source: Ketrax S38 Tunable Lamp



Source: Soraa Helia BR30

High-Bay Lighting

CALiPER Snapshot Results (2017)

- ▶ High-Bay LED products
 - More than 150 products exceed 50,000 lumens
 - Efficacy exceeds fluorescent
 - Improved color quality
 - Narrow light beam pattern
 - Life claims are suspect



Source: Albeo



Source: Cree HXB Series

High-Bay Lighting

Ballast Bypass

- ▶ Filamento VALTO
 - 15,000 to 20,000 lumens
 - Works with BOTH bypass and drop-in

Source: Filamento VALTO



Drop-Ins

- ▶ Lunera Lighting's
 - No need to bypass HID ballast
 - Susan for metal halide
 - Lucy for high-pressure sodium
 - MultiWatt adjusts automatically
 - Up to 14,000 lumens output



Source: Lunera Lighting

High-Bay Lighting

Purpose Built

- ▶ Orion Energy Systems ISON™
 - 11,000 to 68,000 lumens output from 170 to 200 lpw!
 - 77 to 83 CRI
- ▶ Zumbotel CRAFT
 - 17,000 to 34,000 lumens (128 lpw)
 - Built like a tank!
- ▶ Acuity/Holophane Phuzion™ PHS
 - 24,000 lumens @230 watts (100 lpw)
 - 14% uplight
 - Patented borosilicate glass

Source: Orion ISON



Source: Zumbotel CRAFT



Source: Acuity

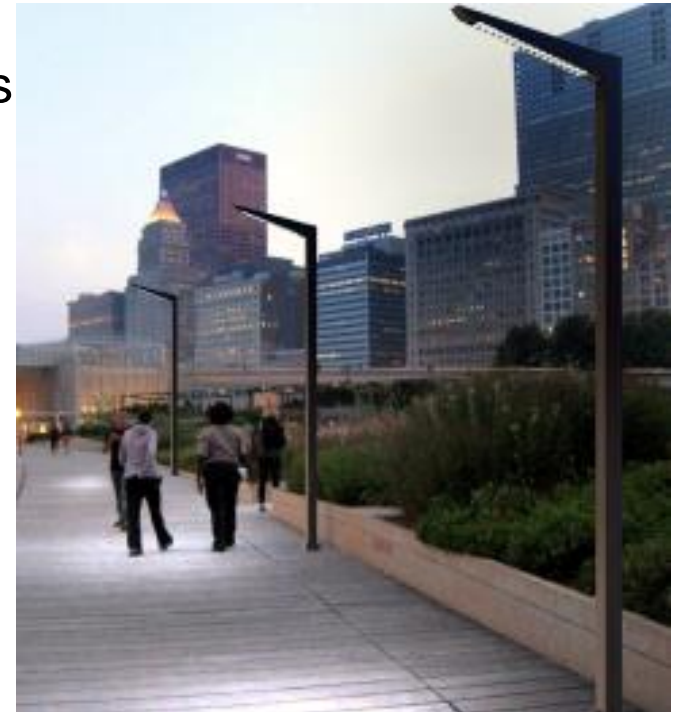
Outdoor Lighting

Street and Area Lighting

- ▶ Color rendering and uniformity for LEDs are better than HPS
 - Minimum illuminance levels equal to HPS (LED perceived as better)
 - Higher efficacy (lumens per watt)
 - Around 50% have a CRI value in the 70s
 - LEDs are *Dark Skies* compliant



LED (left) vs HPS (right)
Source: Beta Lighting & EERE



Source: Architectural Area Lighting

Outdoor Lighting

LED Sports Field Lighting

- ▶ **KMW GigaTera SUFA**
 - 84,000 lumens at 800 watts (105 LPW)
 - 70 to 80 CRI; 50,000 hours life
- ▶ **SpecGrade SportsLighter**
 - Heat pipe thermal management
 - 100,000 hour rated life
 - 168,000 lumens at 1,650 W (100 LPW)
- ▶ **Ephesus All Field LED Sports Light**
 - AirMesh Bluetooth low energy telemetry
 - Up to 83,000 lumen output at 750 watts (110 lpw)



Source: KMW GigaTera SUFA



Source: SpecGrade LED



Source: Ephesus Lighting

Outdoor Lighting

Parking Garage Lighting

- Improved color quality allows for decreased lumen output



Before (HPS)

After (LED)

Source: Progress Energy



Used with permission of Cree, Inc.



Source: Philips Lighting Gardco Softview

Poll Question

- ▶ Would you like someone from PSE&G to contact you?
 - a) Yes
 - b) No

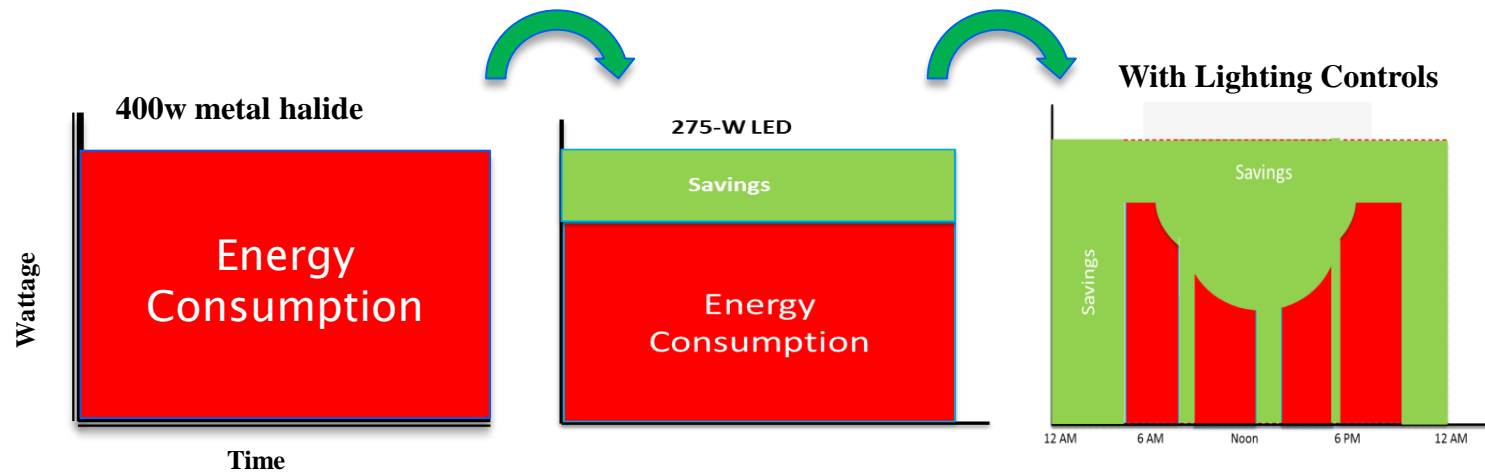
- ▶ How valuable has this Webinar been to you?
 - a) Not valuable at all.
 - b) Slightly valuable.
 - c) Moderately valuable.
 - d) Very valuable.
 - e) Extremely valuable.



Lighting Controls

Leveraging Controls

- ▶ Reduce energy consumption even more!



Lighting Controls

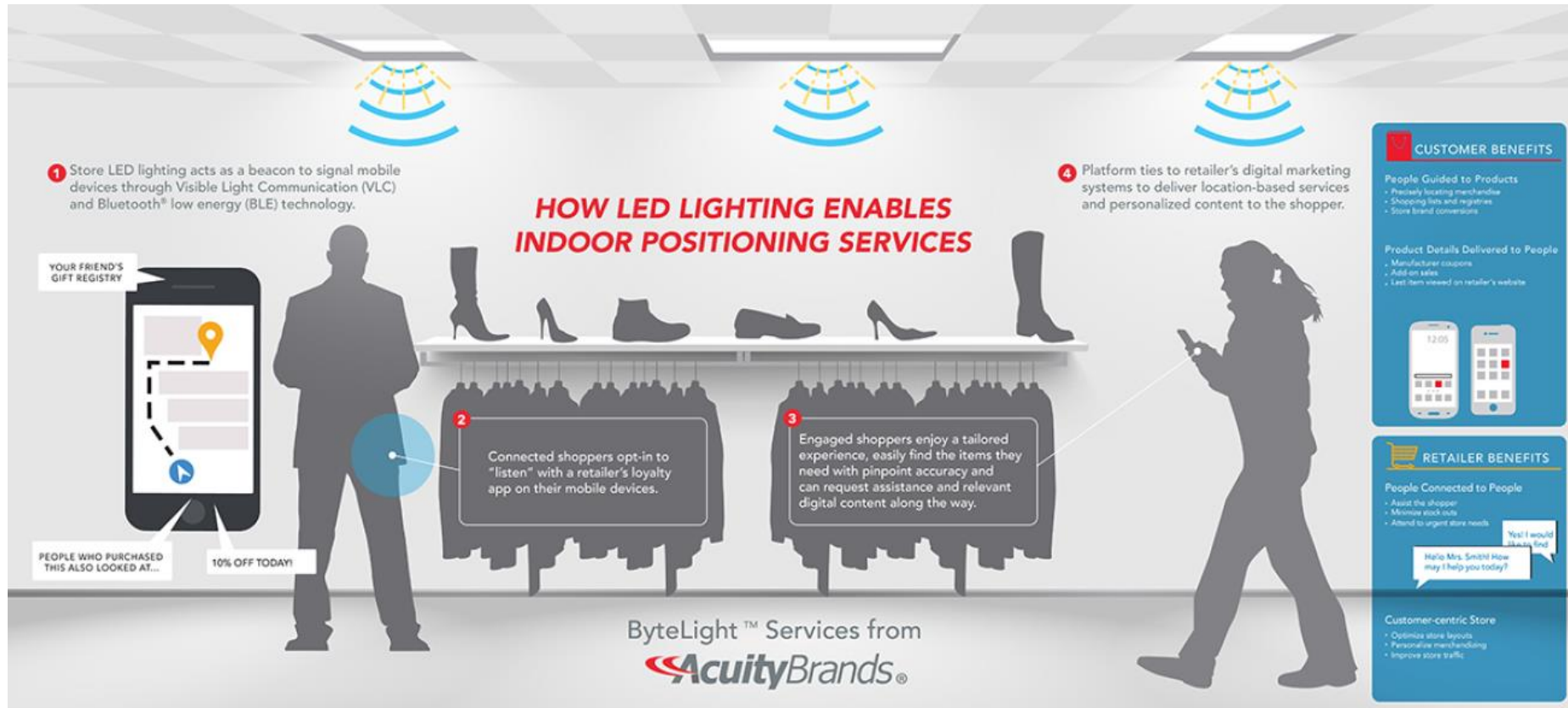
Typical Sequence of Controls

1. Advanced Time Scheduling
2. Occupancy
3. Tuning
4. Daylight Harvesting
5. Personal Control
6. Demand Response
7. Receptacle Control



Lighting Controls

Visible Light Communication (VLC)

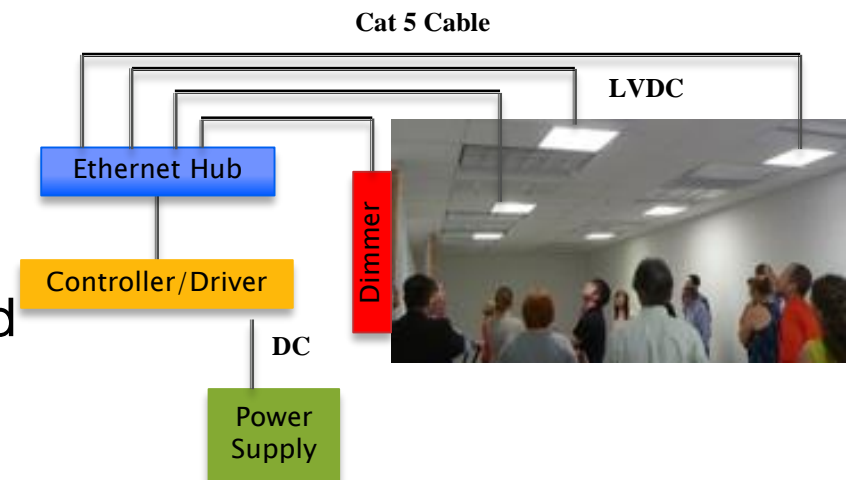
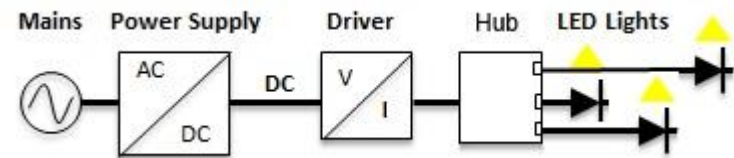


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Lighting Controls

Power-over-Ethernet (PoE)

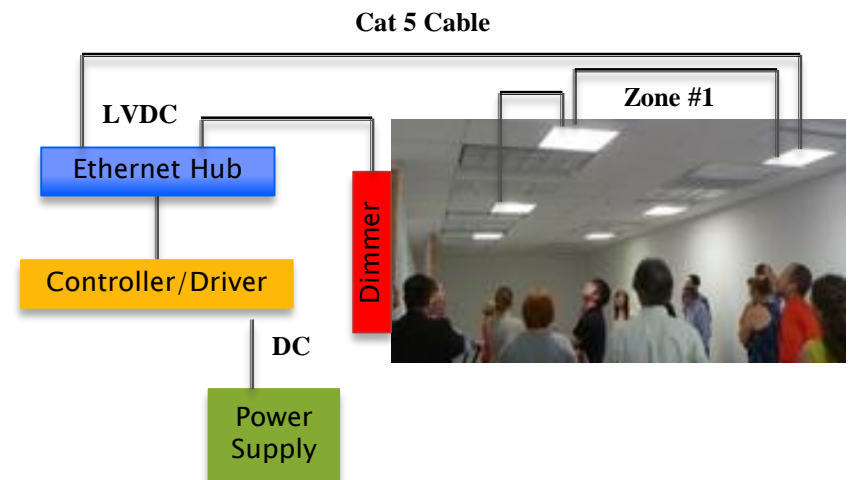
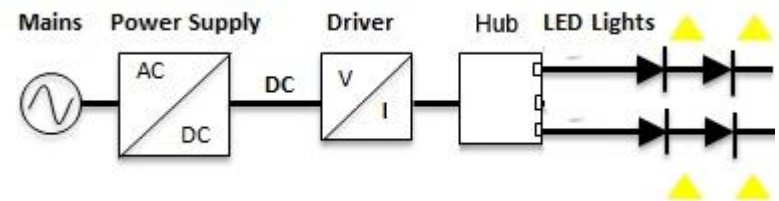
- ▶ Few major suppliers
 - Redwood Systems/CommScope (does not strictly follow PoE)
 - Innovative Lighting (Iowa)
 - nuLEDs (CA)
 - Philips, Eaton Cooper
 - Cree/Cisco SmartCast
- ▶ 30 watts max per Cat 5 cable pair
 - Using additional pairs adds power capacity up to 60W
- ▶ Ports record power consumption
- ▶ IEEE 802.3at spec for PoE+
- ▶ Only one AC/DC converter needed to power many lamps



Lighting Controls

Distributed Low Voltage Power (DLVP)

- ▶ 100 watt channels for DLVP
- ▶ Can be daisy-chained
- ▶ Fixtures have DIP switches
 - Four zone control
- ▶ Fixture occupancy sensor talks to control box
- ▶ Fixture daylighting sensor is independent



PSE&G Webinars:

- ▶ Were you unable to attend one or more of our PSE&G Webinars? Don't worry, check out [this link](#) to the recording of the webinars!

Q&A Session



Questions?

▶ Contact Information:

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 - http://www.pseg.com/business/small_large_business/index.jsp
 - <http://www.njcleanenergy.com/>

