



LED Lighting in Today's Connected Home

Bill Johnson

Market Development Manager

Residential Recessed Lighting - HALO

EATON



Powering Business Worldwide



SOURCE

lighting education center

1121 Highway 74 South
Peachtree City, Georgia 30269
1 hour/ HSW LHES

EATON Lighting Business is a Registered Provider with The American Institute of Architects Continuing Education Systems. Credit earned on completion of this program will be reported to CES Records for AIA members. Certificates of Completion for non-AIA members are available upon request.

This program is registered with AIA/CES for continuing professional registration. As such, it does not include content that may be deemed or construed to be an approval or endorsement by the AIA of any material or construction or any method or manner of handling, using, distributing or dealing in any material or product. Questions related to specific materials, methods and services should be directed to the program instructor.

This presentation is protected by US and International copyright laws. Reproduction, distribution, display and use of the presentation without written permission of the speaker is prohibited. © 2017 Eaton



Learning Objectives

- Participants will gain an understanding of human-centric lighting and trends in residential LED lighting
- Participants will gain knowledge of color tuning LED lighting that may support human visual comfort and circadian rhythm patterns; that continuing industry studies indicate potential for improved daily life, sleep and overall health
- Participants will learn how recessed LED lighting products can help solve air leakage problems; with saving time and money
- Participants will recognize value of high quality lighting solutions that also combine automation with LED lighting
- Participants will be made aware how LED lighting benefits the environment by reducing carbon emissions



Lighting is often overlooked.

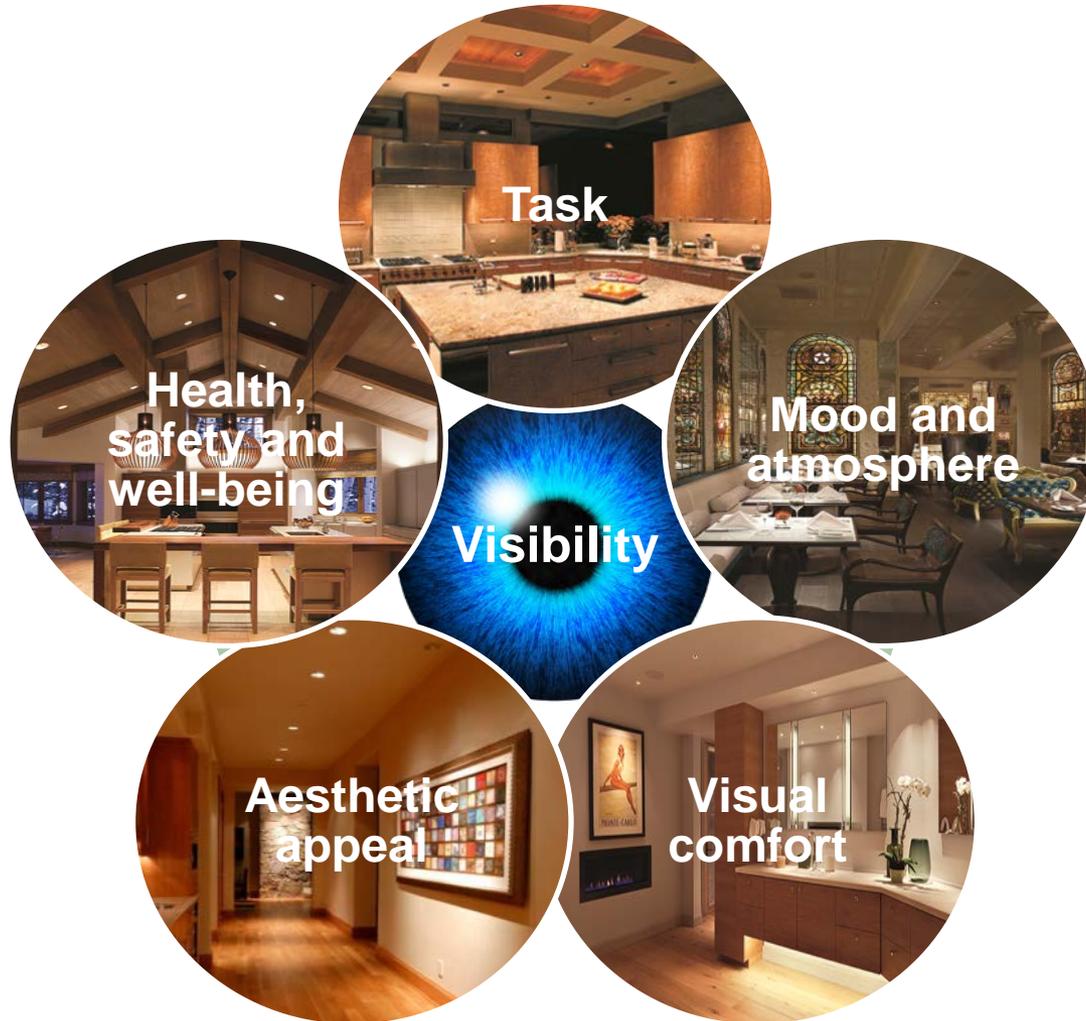
Lighting has the greatest opportunity to reduce energy usage in the home, AND achieve greatest homeowner satisfaction in visual comfort, and safety.

Lighting Defines the Space



- 
- Human Centric Lighting
 - “Color temperature”
 - Color tuning LED lighting

Lighting for Humans



Lighting Considerations

How Much Light Do We Need?



1. What's the room use and age of occupants?
 - Cooking, sleeping, playing, reading, viewing
 - Higher light levels needed with tasks and age



2. What's the room layout and function?
 - Size & reflectance [brightness of walls/ceiling]
 - Visibility & accuracy [hallway v. viewing TV]



3. What's the solution? Layers of light...
 - General downlighting, task lighting, accent, wall washing and specialty: shower, security
 - Energy saving LED luminaires & controls

Modeling with light...

Intensity / Color / Beam / Angle



Above



Behind



Front



Left



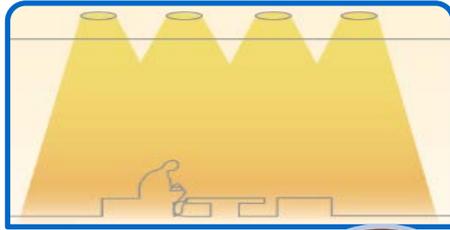
Right



All

Modeling with light...

Intensity / Color / Beam / Angle



General Lighting



Accent Lighting



Wall Wash Lighting



Task Lighting



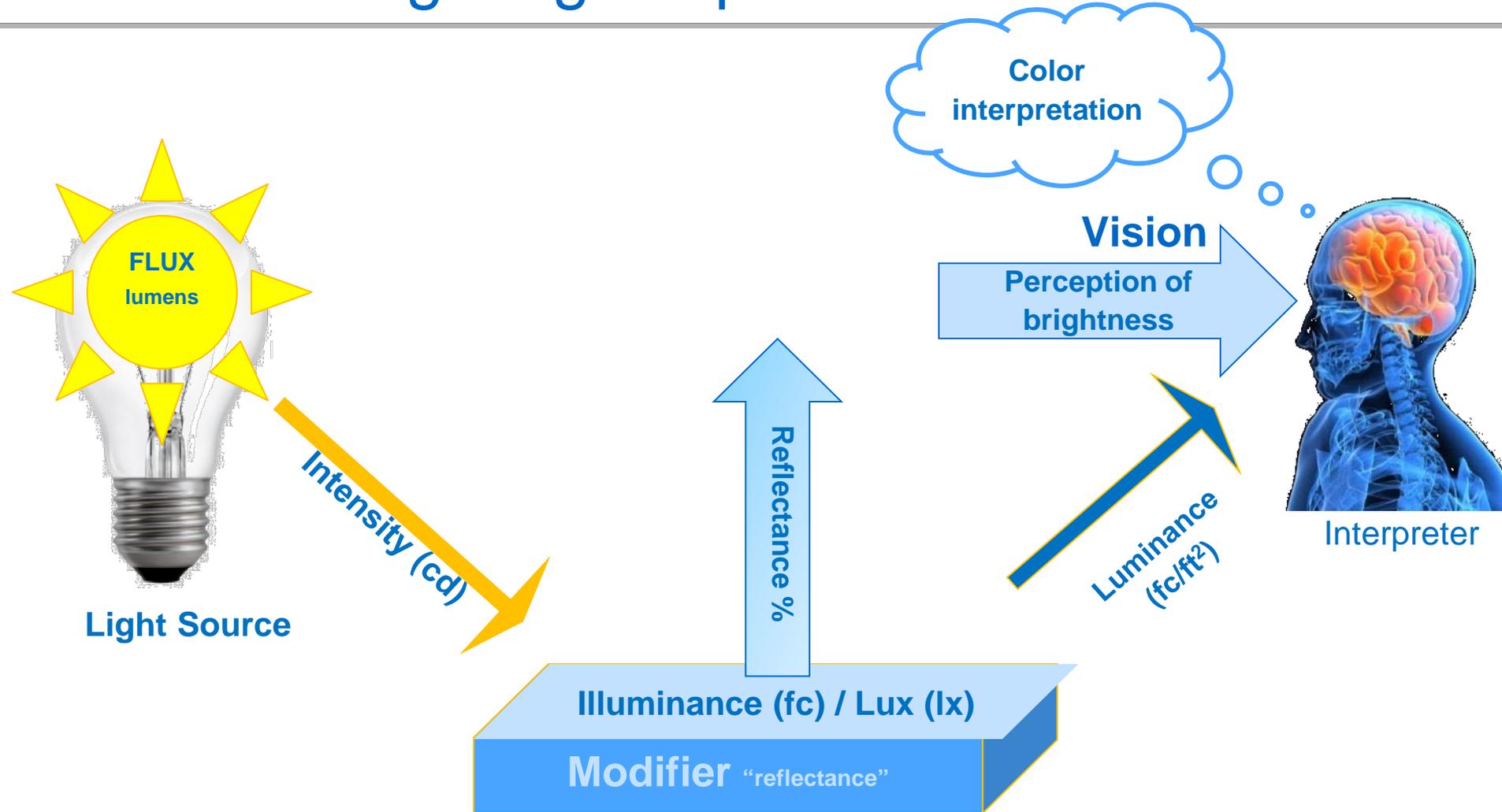
Light & Color

Define... space, mood, aesthetics



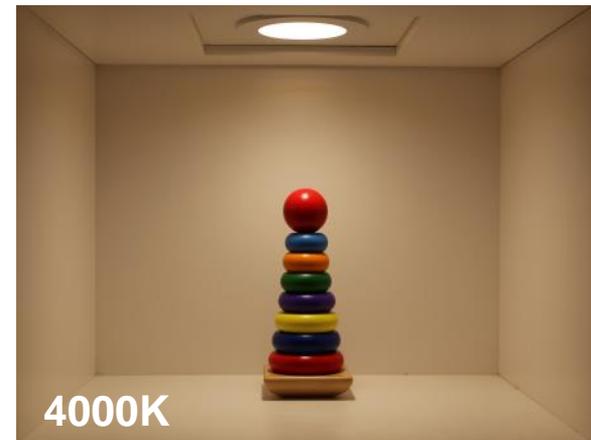
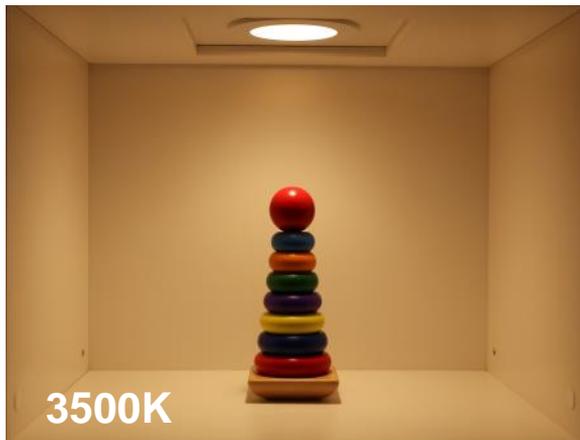
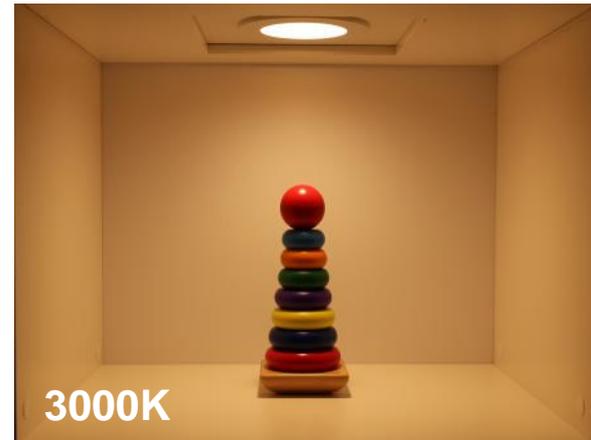
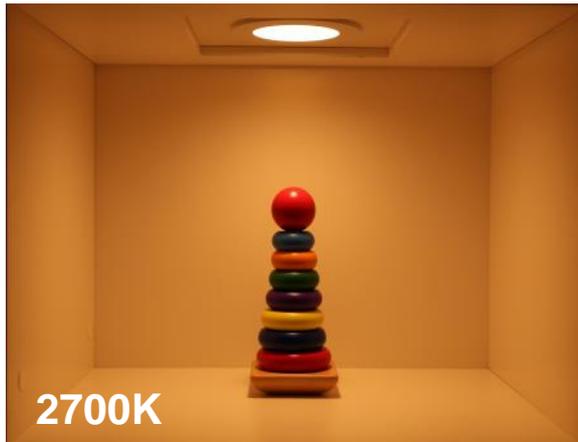
Affects...
visual perception, well-being, safety, energy

The Lighting Sequence... and Color



Light & Color

Correlated Color Temperature (CCT) - Warmth or coolness of a light source. Measured in degrees Kelvin (K)



What is Color Tuning

White color tuning (CCT) LEDs

- Spectral changing color of light ...
 - Warm – neutral white – cool
 - 2700K to 5000K CCT
- Circadian system and health implications
 - Biological clock affected by light and color
 - Warm light...relaxed feeling / evening
 - Cool - white light...energetic feeling / daytime
- Personal color preferences
- Apparent “room temperature” feel
- Complement room décor and finishes
- Set mood
- Research continues into light and health



Dim-to-Warm color tuning LEDs

- Create candlelight effect
- Simulate incandescent.... warm (amber) when dimmed
- 3000K to 1850K CCT ... as light is dimmed



Color Tuning – Research & Case Studies

New Department of Energy case studies

- *Evaluating Tunable LED Lighting in the Swedish Medical Behavioral Health Unit [Seattle]*
- *Evaluating Tunable LED Lighting in Three Texas Classrooms*

Research is evolving in measurement of color-tunable LED lighting

- Human health and behavior – melatonin suppression & stimulus
- Energy savings
- Control interface – convenience and access
- New research driving lighting terminology*
 - “Circadian stimulus”
 - “Equivalent Melanopic Lux”

Department of Energy case studies

Evaluating Tunable LED Lighting in the Swedish Medical Behavioral Health Unit

https://energy.gov/sites/prod/files/2017/08/f36/2017_gateway_swedish-tuning-led-brief.pdf

Evaluating Tunable LED Lighting in Three Texas Classrooms

https://energy.gov/sites/prod/files/2017/10/f37/2017_gateway_tuning-classroom-brief.pdf

*Illuminating Engineering Society 2017

Color Tuning for Residential Construction

White color tuning

- LED luminaire design for spectral color change
- Wireless control automation



2700K nominal

5000K nominal



GEO FENCING



SCHEDULING

GROUPING

HALO LED
connected home

Wireless control of residential lighting

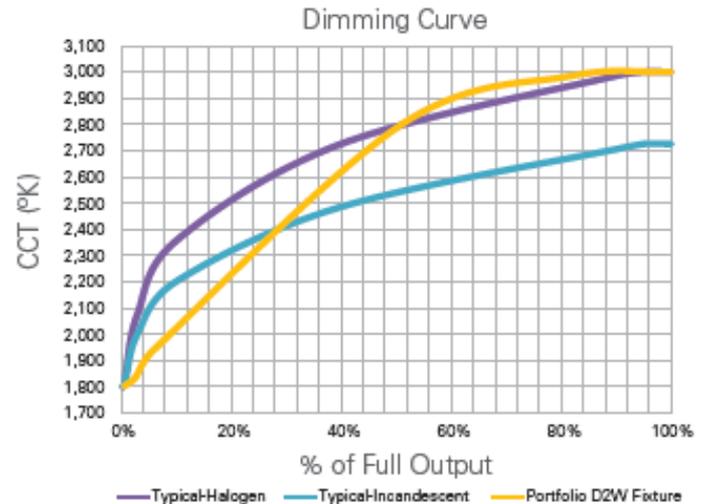
- Automate and control lighting remotely
- Adjust color temperature 2700-6500K (warm to cool)
- Create groups and lighting scenes
- ON/OFF functions remotely
- Dimmable to 1%

compatible with

EATON RLS60WH21A19

Dim-to-Warm

- LED luminaire design for D2W
- Dimmer switch



Color Tuning for Residential Construction DEMONSTRATION

White color tuning

- Color tuning a LED luminaire with continuous control of color temperature from 2700K to 5000K and dimmed lighting levels; using a wireless smartphone app [linked with hub & WiFi internet connection].



Dim-to-Warm

- Dim-to-Warm of a LED luminaire with continuous control of color temperature from 3000K to 1850K; using a standard triac dimmer.

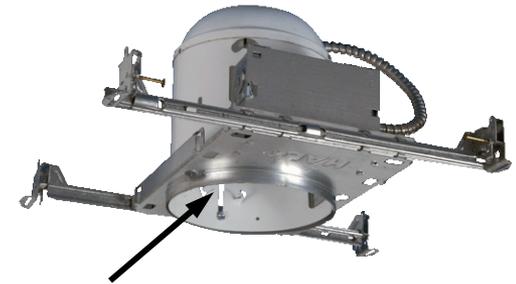


- Recessed lighting...
Air-tight solutions

Air-Tight Evolution

Recessed housings

- Original Non-IC recessed “can”
 - Up to 5.0 cubic feet per minute of air leakage
 - Warm air into cold attics could transfer up to 9 gallons of moisture per can / year
- ICAT recessed “can”
 - Air-tight test ASTM283E, sum: Air leakage rate not more than 2.0 cfm (0.944 L/s) when tested at a 1.57 psf (75 Pa) pressure differential
- Most ICAT “cans” need gasket or caulk on the finished ceiling to seal gap in lip & can



Non-IC can slots



Sealed IC can

Frame gasket per code, but...



Gaps between lip & can to seal after ceiling is in

There are new solutions....

Air Tight Solution #1

New recessed housing

- NEW ICAT recessed “can”
 - Solid lip - No gaps between lip and can
 - No gasket or caulk needed to seal after ceiling is in
 - Compression gasket seals frame, can & ceiling



Look for the ASTM E283 certified label



Gasket seals
Frame - can - ceiling

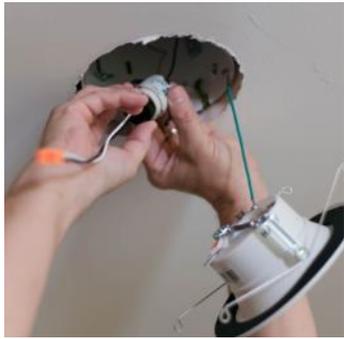
Solid lip means NO gaps



Air Tight Solution #2

Integrated LED Fixtures

- Easy to Install; Save Time, Money & Energy
- Typically <10W to <15W
- Air-tight compliant – regardless of recessed can



1. Screw in Adapter



2. Attach Connector



3. Squeeze & Insert Torsion Springs



4. Guide LED fixture into Recessed Can



- 
- Value in high quality LED lighting solutions
 - Human Factors
 - Functional Factors

LED Lighting Fixtures – Benefits

Human Factors

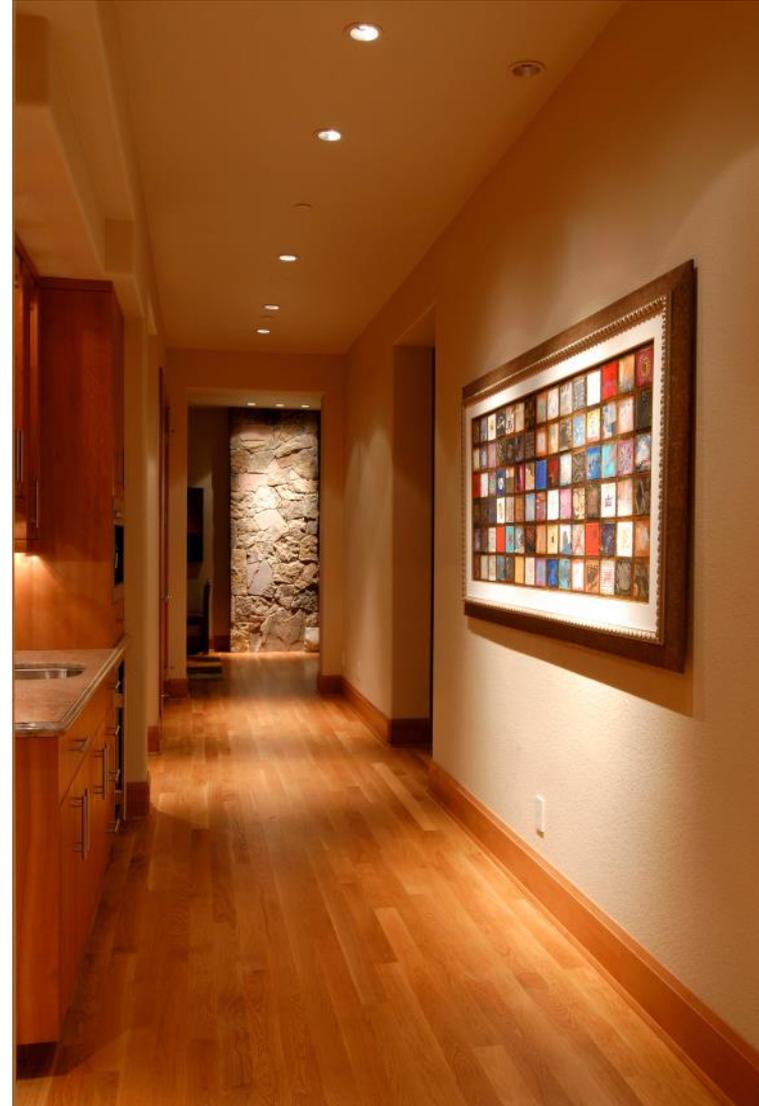
- Range of CCT - Color Temperature
 - Warm to Cool
 - 2700K to 5000K typical
- High CRI – Color Rendering Index
 - Improves vision & aesthetics
- Easily controlled
 - Dimmers, Sensors
 - Home Automation
- Flexibility in lighting design
- Instant lighting
 - No warm up time
- Improved visual acuity
 - Aging population = higher light levels
 - Safety & security



LED Lighting Fixtures – Benefits

Functional Factors

- Long operational time expectation
 - 35,000 to 50,000 hours typical
- Energy efficiency - Lighting & HVAC
 - Lower power <15 Watts typical
 - Lower heat load
- Eco-friendly
 - No mercury & recyclable
- No UV
 - No fading of artwork or fabric
- Adds value to the installed area



Determining the lighting solution

Color, CRI and Footcandles

	Kitchen	Bath	Hallway	Living room	Dining	Bedroom	Utility Laundry	Game / Task	Outdoor
Color Temp (k)	2700 3000 3500	2700 3000 3500	2700 3000	2700 3000	2700 3000	2700 3000	3000 3500	3000 3500	3500+
CRI	90	90	90	90	90	90	90	90	>70
Fixture type	Recessed Track Surface Under Cab Suspended	Recessed Surface Sconce	Recessed Chandelier Suspended	Recessed Table Track Surface	Recessed Sconce	Recessed Sconce Table	Recessed Surface	Recessed Track Suspended	Recessed Surface
Avg Illum. (fc)	Gen: 10-20 Sink: 50 Task: 30-50	Gen: 20-50 Task: 30	Gen: 10-20 Trans: 3-5 Stairs: 10-20	Gen: 10-20 Fire plc: 5-20	Gen: 5-10 Table: 25-50 Art: 10-20	Gen: 5-10 Read: 30-50	Gen: 30-50	Task: 20-50	Entry: 10-20 Security: 30+

- **Task Lighting typically increases for older eyes – up to 100 footcandles**
- **Watch for ceiling fan strobing when installing recessed lights (bedrooms)**
- **For reading place lights slightly behind or to the side**
- **For mirrors and TV/computer screens keep lights to the side - not in front**

LED Lighting Benefits the Environment and Significant Energy Savings

Electrical Products - More Power Less Greenhouse Gas

The best way to achieve energy savings in lighting is to rapidly upgrade existing lighting with more efficient alternatives.

For example, you could replace a regular incandescent fixture with ...

ONE 9.5 watt LED lighting fixture



using a total of **475 kWh** of electricity

INSTEAD OF

25 incandescent bulbs using a total of **3,250 kWh** of electricity



to get **50,000 hours** of basic lighting

Upgrading lighting reduces waste going to landfill and greenhouse gas emissions related to energy consumption



Increasing use of LED lighting can potentially reduce U.S. energy consumption for lighting in the year 2030 alone by

300 TWh* OF ELECTRICITY
(*Tera watt hours)

Or enough electricity to power



U.S. homes or all the homes in CA, NY and OH for a year.

LED Lighting Benefits – Compatibility of Controls and Home Automation



Future of LED lighting in the home

- Smaller & shallower housings



- Flat panel surface mounting



- Thinner profiles



- Wireless Systems



- Speaker integration



- Embedded sensor technology



- Personal lighting control



- Low voltage distribution



LED Lighting in Today's Connected Home

Thank You for Attending!

This concludes the American Institute of Architects
Continuing Education Systems Program



EATON

Powering Business Worldwide