Better than CFL?
Dimmable LED Downlights in Hospitality Facilities

Bob Davis
Pacific NW National Lab
Portland, OR

Ardra Zinkon
Tec Studio, Inc.
Columbus, OH

Next Generation Luminaire (NGL) Demonstration Project: Hilton Columbus Downtown
Registration question

Have you been involved in an LED downlight project (new or retrofit)?

- 43: No, and no plans
- 90: No, but next 12 months
- 1: Yes, with disappointing results
- 47: Yes, with mixed results
- 190: Yes, with favorable results
OUTLINE OF WEBINAR

- Introduction & Background
  - Why it matters
  - Overview of Hilton project & guest room lighting
- Guest room lighting details
  - LED downlights
  - Controls
- Performance data on installed system
  - Light levels & Color data
  - Energy analyses
- Lessons learned / Advice for today’s projects
- Q & A
Why study downlights?

- 700 million downlights installed
  - < 1% are LED
- Current technology
  - 10-40 lms/Watt; 1-10k hours life
- LED technology
  - 50-75 lms/Watt; 20k++ hours life?
- Huge energy & cost saving potential

Lighting for Hospitality: Incandescent / Halogen

- Low initial cost
- Shapes & sizes
- Easy to dim
- Good optical control
- Excellent color rendering
Lighting for Hospitality: Incandescent / Halogen

- Low lumens per watt
- Short life / Frequent replacement
- High operating costs
- Banned?
Lighting for Hospitality: CFL

- Higher lumens per watt
- Much longer life
- Reduced operating costs (energy + maintenance)
Lighting for Hospitality: CFL

- Higher initial cost
- Color quality?
- Instant on / full output?
- Dimmable?
- Guest satisfaction?
Survey of Guest Rooms

5 hotels in 5 cities (AZ, NV, NY, OR)

62 Lamps
  2 LED
  3 Incandescent
  4 LFL
  53 CFL
“Though dimming is a persistent problem with CFLs, Gonzalez notes that major hospitality chains have standardized using switches instead of dimmers in their rooms. Dimmability has been an acceptable sacrifice for energy savings.”

“Meet the replacements”
*Architectural Lighting*, March/April 2013
- citing Domingo Gonzalez of Domingo Gonzalez Associates
Lighting for Hospitality

Can we get back what we sacrificed . . . And more?
Hilton Columbus Downtown

- 450,000 square feet
- $140 million
- HOK & Moody-Nolan
- LEED Gold
- Greater Columbus Convention Center
- Occupancy October 2012
Hilton Columbus Downtown

- 484 guest rooms + 48 suites
- 32,000 ft² event space
- 160 seat restaurant
- Large central atrium w/ 15,000 ft² skylight
- DOE post-occ study March 2014
Lobby Space

Custom LED Sconce
Lobby Space
Restaurant
Pre-function
Glass Connector Bridge
Glass Connector Bridge
OUTLINE OF WEBINAR

- Introduction & Background
  - National energy story: Downlighting & hospitality
  - Overview of Hilton project & guest room lighting

- Guest room lighting details
  - LED downlights
  - Controls

- Performance data on installed system
  - Light levels & Color data
  - Energy analyses

- Lessons learned / Advice for today’s projects

- Q & A
Guest Room Lighting

Type GA1
15 Watt LED

Millwork uplight

Bed light

Mirror lighting
Guest Room Lighting: Goals for downlights

- Energy efficient / LEED goals
- Long life & low maintenance
  - Life not affected by switching / controls
- Dimmable with familiar functionality
- Full output without warm-up
- Single light source appearance
- Fit within 6” height constraint
- Excellent color consistency
  - Downlights visible from atrium
Guest Room Lighting: Downlight selection process

- CFLs?
  - Dimmable? Color? Full output? Life?

- LED options?
  - Reviewed dozens of cut sheets and samples
  - Multiple sources? CCT? Binning spec? Lens / shower option?
  - Full-scale mock-up of two guest rooms

- Portfolio: Eaton’s Cooper Lighting
  - Calculite: Philips Lightolier
Guest Room Lighting: Controls

Priority: Vacancy control

- Bedroom: Auto or manual?
  - Locations made hard-wired sensors difficult
  - Wireless? Problems with dimming

- Bathroom (not code required)
  - Wireless PIR sensor on ceiling

- Master switch (code required)
  - Clear labeling
  - Custom placard
Guest Room Lighting: Controls

To activate the in-room lighting, use the Master ON/OFF switch.
Please turn off the lights upon your exit to help conserve energy.
Guest Room Lighting: Controls

Priority: Dimming control
- Downlights in bathroom
- Downlights near window

Simple rocker switches with slide dimmer
OUTLINE OF WEBINAR

- Introduction & Background
  - National energy story: Downlighting & hospitality
  - Overview of Hilton project & guest room lighting

- Guest room lighting details
  - LED downlights
  - Controls

- Performance data on installed system
  - Light levels & Color data
  - Energy analyses

- Lessons learned / Advice for today’s projects

- Q & A
Photometric Performance

**Desktop**
- 177 - 275 lx
- IES: 200 lx
  (400 for >65)
- Tasklight

**Entrance**
- 120 - 203 lx
- IES: 20 - 40 lx
- Mirror? Closet?

**Bath - Sink**
- 560 lx (H)
- IES: 200-400 lx
- 690 lx w/ mirror
- 250 lx (V)
- IES: 200-400 lx
- 425 lx w/ mirror
## Color Performance

<table>
<thead>
<tr>
<th>Fixture Type</th>
<th>Product Code</th>
<th>CCT</th>
<th>CRI</th>
<th>R&lt;sub&gt;9&lt;/sub&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LED Downlights</strong></td>
<td>Entry1</td>
<td>3060</td>
<td>85</td>
<td>43</td>
</tr>
<tr>
<td></td>
<td>Entry2</td>
<td>3091</td>
<td>84</td>
<td>43</td>
</tr>
<tr>
<td></td>
<td>Window1</td>
<td>3062</td>
<td>84</td>
<td>43</td>
</tr>
<tr>
<td></td>
<td>Window2</td>
<td>3075</td>
<td>82</td>
<td>37</td>
</tr>
<tr>
<td></td>
<td>Bath1</td>
<td>3075</td>
<td>81</td>
<td>37</td>
</tr>
<tr>
<td></td>
<td>Bath2</td>
<td>3071</td>
<td>82</td>
<td>37</td>
</tr>
<tr>
<td></td>
<td>Bath3</td>
<td>3052</td>
<td>84</td>
<td>42</td>
</tr>
<tr>
<td></td>
<td><strong>Mean</strong></td>
<td>3069</td>
<td>83</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td><strong>Range</strong></td>
<td>39</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>CFL Bed Light Fixtures</strong></td>
<td>Bed1</td>
<td>2753</td>
<td>82</td>
<td>-2</td>
</tr>
<tr>
<td></td>
<td>Bed2</td>
<td>2843</td>
<td>80</td>
<td>-3</td>
</tr>
<tr>
<td></td>
<td><strong>Mean</strong></td>
<td>2798</td>
<td>81</td>
<td>-3</td>
</tr>
<tr>
<td></td>
<td><strong>Range</strong></td>
<td>90</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>LFL Bed Millwork Fixtures</strong></td>
<td>Mill1</td>
<td>3762</td>
<td>85</td>
<td>29</td>
</tr>
<tr>
<td></td>
<td>Mill2</td>
<td>3841</td>
<td>85</td>
<td>29</td>
</tr>
<tr>
<td></td>
<td><strong>Mean</strong></td>
<td>3802</td>
<td>85</td>
<td>29</td>
</tr>
<tr>
<td></td>
<td><strong>Range</strong></td>
<td>79</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>LFL Mirror Fixtures</strong></td>
<td>Left</td>
<td>3022</td>
<td>85</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Right</td>
<td>2979</td>
<td>85</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td><strong>Mean</strong></td>
<td>3001</td>
<td>85</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td><strong>Range</strong></td>
<td>43</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Energy Savings & Economics

Why LED?
- Guest experience: functionality, aesthetics, lighting quality

First cost?
- 10% less to 20% more than dimmable CFL versions at “book”

Energy code?
- Guest room lighting 20% below allowed power (145k kWh saved per year)
- Controls to further reduce energy use
- Other SSL opportunities?
## Energy Savings & Economics

<table>
<thead>
<tr>
<th></th>
<th>6” Downlights</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LED</td>
</tr>
<tr>
<td><strong>Lamp output (lms)</strong></td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Luminaire output (lms)</strong></td>
<td>928</td>
</tr>
<tr>
<td><strong>Input power (W)</strong></td>
<td>15</td>
</tr>
<tr>
<td><strong>Luminaire efficacy (lm/W)</strong></td>
<td>62</td>
</tr>
<tr>
<td><strong>Annual electricity use (kWh)</strong></td>
<td>203,330</td>
</tr>
<tr>
<td><strong>Average illuminance in entry (lx)</strong></td>
<td>190</td>
</tr>
<tr>
<td><strong>Illuminance on face at mirror (lx)</strong></td>
<td>68</td>
</tr>
</tbody>
</table>
Lighting quality

Entry area renderings comparing PAR halogen (left) and LED (right) downlights
OUTLINE OF WEBINAR

- Introduction & Background
  - National energy story: Downlighting & hospitality
  - Overview of Hilton project & guest room lighting

- Guest room lighting details
  - LED downlights
  - Controls

- Performance data on installed system
  - Light levels & Color data
  - Energy analyses

- Lessons learned / Advice for today’s projects

- Q & A
LED Technology

- Have clear evaluation criteria defined at the start
  - What is important for this project?
- Evaluate multiple samples for construction quality, color quality & consistency, visual aesthetic
- Mock-up fixtures w/ full controls to check compatibility & reliable operation
- Specified product ≠ Bid product ≠ Ordered product
  - LED technology is moving fast!
Lessons learned from the Hilton Columbus Downtown

Practical project considerations

- Communication challenges w/ multi-location teams
  - Team members in Columbus, Chicago, Atlanta
- Ownership of spec and ordering
  - Hard-wired vs. plug-in
  - Electrical vs. Interior / decorative
  - Lamping, color, voltages, etc.
“The bathroom has self monitoring lighting which is huge for me. I can't stand screaming bright lights without any options for self dimmering (sic) as it's the biggest pet peeve I have regarding hotel rooms. These are cool in that you can lighten up or lower down to your preference.” (Yelp)

“Nice uplights in the room.” (Expedia)

“Instructions for operating all electronics, including lights, were easy and evident.” (Hotels.com)
Acknowledgments

- Phil Hornstra
  - Director of Property Operations for the Hilton Columbus Downtown

- Cheryl Fabian
  - Marketing Manager for Eaton’s Cooper Lighting Business

- Scott Pease
  - Scott Pease Photography
OUTLINE OF WEBINAR

- Introduction & Background
  - National energy story: Downlighting & hospitality
  - Overview of Hilton project & guest room lighting

- Guest room lighting details
  - LED downlights
  - Controls

- Performance data on installed system
  - Light levels & Color data
  - Energy analyses

- Lessons learned / Advice for today’s projects

- Q & A
Related resources

Hilton Columbus Downtown reports
https://www4.eere.energy.gov/alliance/activities/technology-solutions-teams/lighting-electrical/downlight

DOE Better Buildings
http://energy.gov/better-buildings

DOE Solid State Lighting
- http://energy.gov/eere/solid-state-lighting
- http://www.ngldc.org/