• Special Awareness Among LED Product Offerings
• Display Lighting
• General Lighting – normal ceiling height spaces
• General Lighting – high bay spaces
• Outdoor Area Lighting
• Skylights
• Commentary on Lighting Controls Possibilities
PROGRAM TYPES

**Prescriptive Incentives**
Specific Products and Retrofits
- Indoor new lighting
- Indoor retrofits
- Outdoor new lighting
- Outdoor retrofits
- Requires use of listed qualified products

**Custom Incentives**
Systems Approach and Unique Situations, e.g.
- Integrated Lighting Controls
- Advanced technologies and products
- Unique situations and problems

**SMART Lighting**
For applications using a SMART lighting design professional
- Requires advanced controls and acceptance testing
- Increases energy incentive by 50%
- Designed to be at least 30% better than code

*focus on energy*
Partnering with Wisconsin utilities
LED AWARENESS
TESTING MUST BE DONE AND CERTIFIED

- DOE Caliper Reports
- LightingFacts Listing
- DLC Listings
- CEE Listings
TESTING AND APPROVING AGENCIES

- UL Standards and Listings by UL or other testing agencies
- LED Photometric performance IES LM79
- LED Lumen maintenance IES LM80
- DOE Lighting Facts information
- Design Lights Consortium listings of approved luminaires and commercial lighting systems
- ENERGY STAR listings of approved LED products
- Consortium for Energy Efficiency Listings (fluorescent)
• Focus on Energy does not endorse any particular brand or product

• Photos in this program of current products and applications are examples only

• Products listed by agencies like DLC, CEE, US DOE Caliper, and US EPA ENERGY STAR® have been tested and determined to perform according to listing rules and should be given top consideration
PROBLEMS OF THE LED INDUSTRY

- Unsubstantiated performance claims
- No data (LM79 or LM80)
- Published claims differ from measured data
- Not DLC listed or listing misrepresented
- Use of Scotopic to Photopic ratio (S/P ratio) in marketing materials and “white papers”
- Promoting blue-white light as “better” for any reason
- “Healthy” lamps and lighting systems
- Poor product quality, color and/or performance
- Rapid depreciation
- No warranty or lack of warranty service
WHAT ABOUT TLEDS (TUBULAR LED)?

Presently, 110 products are DLC listed.

For example, 1 Brand P lamp is listed; Brand P sells other TLED’s.
## Comparing a Pair of Four Foot Lamps

<table>
<thead>
<tr>
<th>Brand P Line Voltage T8 LED</th>
<th>Brand P External Driver T8 LED</th>
<th>Brand P T8 Fluorescent</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Rewire fixture</td>
<td>• Replace ballast with driver</td>
<td>• Replace ballast with efficient .71BF ballast program start 46 watts</td>
</tr>
<tr>
<td>• Integral driver</td>
<td>• Rewire fixture</td>
<td>• 3100 lumen T8 lamps F32T8/841/HP</td>
</tr>
<tr>
<td>• 1650 lumens per lamp</td>
<td>• 2433 lumens per lamp (per DLC)</td>
<td>• $4 per lamp</td>
</tr>
<tr>
<td>• 19 watts per lamp</td>
<td>• 48 watts per 2 lamps input to driver</td>
<td>• $22 per ballast</td>
</tr>
<tr>
<td>• $40 per lamp</td>
<td>• $50 each per lamp</td>
<td>• Lamp rated 36,000 hours@ 12 hrs (PS)</td>
</tr>
<tr>
<td>• Lamp rated 40,000 hours</td>
<td>• $22 driver</td>
<td>• LLD = .97</td>
</tr>
<tr>
<td>• LLD = .85</td>
<td>• Lamp rated 50,000 hours</td>
<td></td>
</tr>
</tbody>
</table>

LLD = Lamp lumen depreciation at 50% of rated life
## Comparing a Pair of Four Foot Lamps

<table>
<thead>
<tr>
<th></th>
<th>Brand P Line Voltage T8 LED</th>
<th>Brand P External Driver T8 LED</th>
<th>Brand P T8 Fluorescent</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Initial Lumens</strong></td>
<td>87 initial lumens per watt</td>
<td>104 initial lumens per watt</td>
<td>96 initial lumens per watt</td>
</tr>
<tr>
<td></td>
<td>73.8 mean lumens per watt</td>
<td>88.5 mean lumens per watt</td>
<td>92.8 mean lumens per watt</td>
</tr>
<tr>
<td><strong>Cost</strong></td>
<td>$80 plus labor to install</td>
<td>$122 plus labor to install</td>
<td>$34 plus labor to install</td>
</tr>
<tr>
<td><strong>Light Output</strong></td>
<td>Initial light output 3300 lumens from 2 lamps (33% less light)</td>
<td>Initial light output 4866 lumens from 2 lamps</td>
<td>Initial light output 4402 lumens from 2 lamps (9% less light)</td>
</tr>
<tr>
<td></td>
<td>Initial power input 38 watts (37% reduction)</td>
<td>Initial power input 48 watts (20% reduction)</td>
<td>Initial power input 46 watts (23% reduction)</td>
</tr>
<tr>
<td><strong>Lamp Life</strong></td>
<td>40,000 hours</td>
<td>50,000 hours</td>
<td>36,000 hours</td>
</tr>
</tbody>
</table>
SUMMARY: TLED REPLACEMENT LAMPS

- Fluorescent is comparably energy efficient and long life, but less expensive
- Most TLED’s reduce light levels to save impressive amounts of energy
- Fluorescent color is comparable or better
- Fluorescent can be dimmed and still cost less
- TLED makes sense in some circumstances, e.g. in cold temperatures
- LED cost will fall over time
- There is a lot of dishonest TLED marketing
DISPLAY LIGHTING TYPES

• Track lighting
• Monopoint accents
• Low voltage/monorail lighting
• Display case lighting
• Freezer case lighting
• Shelf/undershelf lighting
Most existing light sources include

- **PAR38 halogen**
  - typically 60-90 watts
- **PAR30 halogen**
  - 50-75 watts
- **MR16 halogen**
  - 37-50 watts
PAR38 REPLACEMENT

• Average existing lamp 75 watts, 1100 lumens, CRI~97, 3000K, 3000 hours
• Replacement LED lamp nom. 20 watts, 1100 lumens, CRI~90, 3000K, 25,000 hours

Buyer Considerations

• Quality of Product
• Color rendering index and color quality
• Beamspread, center beam candlepower and beam quality
RECENT US DOE/PNNL TESTING

Comparing spot lamps (15°)
## PAR38 REPLACEMENT

### Halogen 75 watt
- 6000 annual hours
- 3 months life
- Lamp cost $6.00
- Lamp cost/year $12.00
- Energy cost/year $20.25
- Annual cost $32.25

### LED 20 watt
- 6000 annual hours
- 4 years life
- Lamp cost $40.00
- Lamp cost/year $10.00
- Energy cost/year $5.40
- Annual cost $15.40
- **PAYBACK in 28 months**
<table>
<thead>
<tr>
<th>PAR30 REPLACEMENT</th>
<th>Halogen 50 watt</th>
<th>LED 12 watt</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>6000 annual hours</td>
<td>6000 annual hours</td>
</tr>
<tr>
<td></td>
<td>3 months life</td>
<td>4 years life</td>
</tr>
<tr>
<td></td>
<td>Lamp cost $6.00</td>
<td>Lamp cost $30.00</td>
</tr>
<tr>
<td></td>
<td>Lamp cost/year $12.00</td>
<td>Lamp cost/year $7.50</td>
</tr>
<tr>
<td></td>
<td>Energy cost/year $13.50</td>
<td>Energy cost/year $3.24</td>
</tr>
<tr>
<td></td>
<td>Annual cost $25.50</td>
<td>Annual cost $10.74</td>
</tr>
</tbody>
</table>

- **PAYBACK in 24 months**
MR16 REPLACEMENT

Halogen 35-50 watt
- 6000 annual hours
- 3 months life
- Lamp cost $5.00
- Lamp cost/year $10.00
- Energy cost/year $13.50
- Annual cost $23.50

LED 12 watt
- 6000 annual hours
- 4 years life
- Lamp cost $30.00
- Lamp cost/year $7.50
- Energy cost/year $3.24
- Annual cost $10.74
- PAYBACK in 28 months
DOWNLIGHT REPLACEMENT

- LED
- Match color of other lights (2700K, 3000K, 4000K)
- CRI>80
- 850 lumens – 8.8 watts
- 1250 lumens – 12.8 watts
- 2000 lumens – 20.6 watts
- 3000 lumens – 30.9 watts
- Dimmable
WHAT TO LOOK FOR

Key Features & Benefits

- 95 typical CRI
- Excellent color quality – within a 3-step MacAdam ellipse
- R9 greater than 60
- Assembled in USA
- No warm up time, instant on with full light output and stable color
- Lasts up to 20 times longer than comparable PAR lamps
- Available in 2700K and 3000K color temperature
- Reduces energy consumption up to 80%
- UV and IR free
- RoHS compliant
- Dimmable to 10%
- Mercury and lead free
- Long life: up to 50,000 hours (L70)
- Suitable for damp locations

Application Notes

1. Operating Temperature -40°F and +113°F (-40°C and +45°C)
2. Suitable for outdoor use when used in a UL rated fixture where protected from weather
3. Use in fixtures that support 2lb. lamp
4. Not for use with emergency light fixtures or exit lights
5. Not for use in enclosed fixture
SUGGESTED CHOICES

General Merchandise
- Color temperature 3000K
- CRI 80 minimum

Color Critical Merchandise
- Color temperature 3000K
- CRI 90 minimum
INCENTIVES FOR INCANDESCENT REPLACEMENT

- ENERGY STAR LED Replacement Lamps
  - Replacing incandescent up to 40W $5/lamp
  - Replacing incandescent 41-120W $10/lamp PLUS Q3 Special offering of $5/lamp bonus (Chains and Franchises Only!)

- CMH Integral Lamps and Fixtures
  - 25W or less replacement lamp replacing 70-100W incandescent flood or spot $15/lamp
  - 20-70W CMH fixtures replacing incandescent $25/fixture

- LED Fixtures: Downlights/Accent lights/Track
  - Replace 60-100W incandescent $15/fixture
  - Replace incandescent fixture greater than 100W OR HID 50W to 100W $30/fixture
POTENTIAL PROBLEMS FOR REPLACEMENT LAMPS

• Does not last 4 years (24,000 hours)
• Dimming issues (rarely a concern in retail)
• Color quality issues
  – 80 CRI common
  – 85-90 desirable
  – 95 or more possible and may be needed for some displays
• Beam quality issues
  – Very few can produce a tight beam 15° or less (Spot)
  – Some can produce a decent 25° beam (Narrow Flood)
  – Most can produce a flood 40° beam (Flood)
  – Too many have terrible field and spill control
OTHER DISPLAY LIGHTING SYSTEMS

LED is good in close quarters

- Refrigerated and freezer
- Enclosed display
- Jewelry
- Open display
GENERAL LIGHTING – NORMAL CEILING HEIGHT
NORMAL CEILINGS AND MOUNTING HEIGHTS

Lighting mounted below ~14’
- T-bar ceiling tile systems
- Sheet rock ceilings
- Clouds
- Open to structure
TROFFER ALTERNATIVES (INCLUDING SURFACE VERSIONS)

Parabolic – 55 to 80% efficient

Basket 45-75% efficient

Lens troffer – 70 to 88% efficient

High performance lens – 80 to 90% efficient
FLUORESCENT VERSUS LED TROFFERS

Fluorescent

- System 85 mean lumens per watt
- Standard color temperatures
- 82-86 CRI
- Dimmable
- Lamp life 36,000 hours or more
- 5100 initial lumens @ 56 w
- $.0245 per lumen

LED

- System 105 mean lumens per watt
- Standard color temperatures
- 80 or 90 CRI
- Dimmable
- Fixture life >>50,000 hours
- 5000 initial lumens at 50 watts
- $0.06 per lumen
LINEAR RECESSED LIGHTING

Recessed lens continuous row

Recessed lens continuous row

Recessed continuous trough (supermarket trough)

Best with LED

LED or Fluorescent

Fluorescent
ARCHITECTURAL SUSPENDED LUMINAIRES

- Direct or direct indirect preferred for efficiency
- LED or fluorescent versions available
- Simple, stylish or themed
SUSPENDED INDUSTRIAL STYLE LUMINAIRES
Best Choices for New Construction

- High performance ("HPT8") T-8 lamps or T-5 lighting systems with high efficiency ballasts (including high efficiency reduced wattage ballasts and/or lamps called "RWT8")
- Dimming ballasts or stepped dimming ballasts
- Efficient luminaires
- Prefer direct or semi direct lighting
BEST CHOICES FOR RETROFITS

• High efficiency T8 lamps and electronic ballasts (HPT8)
• Reduced wattage high efficiency T8 lamps and electronic ballasts (RWT8)
  – Low ballast factor ballasts
  – Low wattage lamps
• LED Panel Retrofit Kits (not TLED lamps)
• Consider dimming
MOST EFFICIENT

- Dedicated (not TLED) LED troffers or pendants
- With dimming to reduce light levels when full light is not needed
LINEAR FIXTURE INCENTIVES

• 2x4 High Performance Troffers
  – $10 2L HPT8 or RWT8/Fixture efficiency >=80%
  – $15 DLC listed LED linear panel, <=55W, >= 4,000 lumens

• HPT8 retrofits/RWT8 retrofits
  – $3 to $7/fixture
WAREHOUSE AND HIGH CEILING SPACES

• Lighting mounted above ~ 14’
• Commercial lighting “high bay”
• Industrial lighting terms
  – Spaces up to 25’ called “low bay”
  – Taller spaces called “high bay”

Hint for efficiency: white ceiling
ALTERNATIVES IN FLUORESCENT

High bay fluorescent

Representative Products

• 4 lamp T5HO @49 w = 208 watts
• 20,000 lumens @ 95% fixture efficiency = 19,000 lumens initial and 17,500 mean lumens
• Narrow, wide or aisle beam
• 6 lamp T5HO = 28,500 lumens initial and 26,250 mean lumens at 308 watts

Options include

• T8 lamps (longer life)
• Dimming and multi level ballasts
ALTERNATIVES IN LED (ALL 4000K >75 CRI)

- 108, 145, 218 and 292 watt versions
- Narrow, medium and wide beams
- 108 w/8,856 lumens
- 292 w/23,944 lumens

- 93 watts, 6461 lumens
- Wide beam
- Aisle beam available

- 112, 139 and 169 watt versions
- Narrow, medium and wide beams
- 112 watts/7975 lumens (80 CRI)
- 139 watts/9969 lumens (80 CRI)
ALTERNATIVES IN LED (ALL 4000K >75 CRI)

- 1 to 12 module versions
- Narrow, medium and wide beams
- Aisle beam available
- 79 to 125 watt modules
- 104 w/9,177 lumens
- 61-385 watt versions (80 CRI, 4500K)
- Medium (“high bay”) and Wide (“low bay”) beam
- 129 w/11,275 lumens

Summary
Typical Luminaire 4000-4500K
Typical efficacy of luminaire 75 to 90 initial LPW/ 63 to 77 mean LPW
Up to about 385 watts in one box/1500 watts using modular assemblies
ALTERNATIVES IN HID

OLD - Original Probe Start Metal Halide w/magnetic ballast
• 400 watt/36,000 lumens/60% LLD/62 CRI @ 4200K – 458 watts
• 250 watt/20,000 lumens/60% LLD/62 CRI @ 4200K – 305 watts

NEW - Ceramic Metal Halide w/electronic ballast
• 400 watt/36,000 lumens/80% LLD/90 CRI @ 4200K – 422 watts
• 250 watt/22,000 lumens/80% LLD/90 CRI @ 4200K – 269 watts

Fixture Efficacies

OLD HID LIGHTING
400w lamp/magnetic ballast = 78 initial LPW/47 mean LPW
250w lamp/magnetic ballast = 65 initial LPW/39 mean LPW

NEW HID LIGHTING
400w lamp/electronic ballast = 85 initial LPW/68 mean LPW
250w lamp/electronic ballast = 82 initial LPW/65 mean LPW
ALTERNATIVES IN INDUCTION

• Long life alternative
• Representative Data
  – (2) 150 watt lamps, 24030 initial fixture lumens, 312 watts, 77 initial lumens per watt, 69 mean lumens per watt
  – Requires lamp specific optics
  – 100,000 hour lamp life
  – 4100K, 80 CRI
<table>
<thead>
<tr>
<th>Lamp</th>
<th>Initial Fixture LPW</th>
<th>Mean Fixture LPW</th>
<th>Cost/initial lumen</th>
<th>Watts per 20K mean lumens</th>
<th>Lamp Life in hours</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluorescent T5HO</td>
<td>91</td>
<td>85</td>
<td>$0.015</td>
<td>235</td>
<td>24K</td>
<td>Cold not OK</td>
</tr>
<tr>
<td>Fluorescent T8</td>
<td>97</td>
<td>92</td>
<td>$0.013</td>
<td>217</td>
<td>36K</td>
<td>Neither hot/cold</td>
</tr>
<tr>
<td>LED</td>
<td>75-90</td>
<td>63-77</td>
<td>$0.045</td>
<td>260-317</td>
<td>50K</td>
<td>Cold OK</td>
</tr>
<tr>
<td>HID Magnetic old</td>
<td>78</td>
<td>47</td>
<td>$0.005</td>
<td>425</td>
<td>20K</td>
<td>Cold OK</td>
</tr>
<tr>
<td>HID electronic new</td>
<td>85</td>
<td>68</td>
<td>$0.015</td>
<td>294</td>
<td>20K</td>
<td>Cold OK</td>
</tr>
<tr>
<td>Induction</td>
<td>77</td>
<td>69</td>
<td>$0.017</td>
<td>290</td>
<td>100K</td>
<td>Cold OK</td>
</tr>
</tbody>
</table>
HID REPLACEMENT LED LAMPS

Sampling of several products

- 17,200 initial lumens, 5000K, 80 CRI, 140 degree beam (very wide), 180 watts
- 10,000 initial lumens, 5500K, 80 CRI, 130 watts, no beamspread information
- 12,000 initial lumens, 5700K, 84 CRI, 150 watts, no beamspread information
- 10,170 initial lumens, 5500K, 72 CRI, 122 watts, many beamspread options, DLC listed

All of these lamps claim to replace 400 watt metal halide.

SUMMARY OF OPTIONS

- Products are around 80 initial lumens per watt
- Most require internal rewiring of MH luminaire
- Most have no candlepower control
- A used 400 w metal halide is at least 20,000 lumens – can’t be replaced without loss of light, but big energy savings are possible
HIGH BAY INCENTIVES

Must be permanent luminaire hard wired conversions of “old” metal halide to:

• Pulse start or ceramic metal halide
• High bay fluorescent
• LED high bay fixture (not screw based adaptor)
• Induction high bay fixture (not screw base adaptor)

• $35-$60 per HID fixture replaced
• Occupancy sensors $15/fixture controlled
SITES: POLES, BOLLARDS, WALLPACKS
WHY LED IS DIFFERENT

• More uniform lighting
• Less light at base of pole
• Lower average light level
• Lower wattage possible
• Same pole count and height
• Use 40% of the watts of magnetic ballasted metal halide
• Use 60% of the watts of HPS
# Pole Lighting Options

<table>
<thead>
<tr>
<th>Metal Halide</th>
<th>High Pressure Sodium</th>
<th>LED</th>
</tr>
</thead>
<tbody>
<tr>
<td>- White light CRI 65</td>
<td>- Pink-yellow light CRI 21</td>
<td>- White light CRI 75</td>
</tr>
<tr>
<td>- 39 mean lumens per watt (250 watt)</td>
<td>- 78 mean lumens per watt (150 watt)</td>
<td>- 75 mean lumens per watt (90 watt)</td>
</tr>
<tr>
<td>- Shoebox fixture $250 plus labor to install</td>
<td>- Shoebox fixture $250 plus labor to install</td>
<td>- Shoebox fixture $600 plus labor to install</td>
</tr>
<tr>
<td>- Average mean light level 1.5 footcandle</td>
<td>- Average mean light level 1.8 fc</td>
<td>- Average mean light level 1.1 fc</td>
</tr>
<tr>
<td>- Minimum light level 0.1 footcandle</td>
<td>- Minimum light level 0.12 footcandle</td>
<td>- Minimum light level 0.12 footcandle</td>
</tr>
<tr>
<td>- Lamp life <strong>20,000</strong> hours</td>
<td>- Lamp life 30,000 hours</td>
<td>- Lamp life &gt;50,000 hours</td>
</tr>
<tr>
<td>- Energy <strong>$120</strong>/year</td>
<td>- Energy <strong>$75</strong>/year</td>
<td>- Energy <strong>$36</strong>/year</td>
</tr>
</tbody>
</table>
LED POLE LIGHT INCENTIVES

• Pole Lights – replacing 70-400W HID
  – HID to LED $20-$60/fixture
  – HID to Linear Fluorescent $15-50/fixture
  – HID to Induction $15-$50/fixture

• Exterior Lighting Optimization
  – Contractor based program
  – Mounting height over 15’
  – Operate 12 hours/night
# WALL PACK LIGHTING OPTIONS

<table>
<thead>
<tr>
<th>Metal Halide</th>
<th>High Pressure Sodium</th>
<th>LED</th>
</tr>
</thead>
<tbody>
<tr>
<td>White light CRI 65</td>
<td>Pink-yellow light CRI 21</td>
<td>White light CRI 75</td>
</tr>
<tr>
<td>26 mean lumens per watt (50 watt)</td>
<td>44 mean lumens per watt (35 watt)</td>
<td>75 mean lumens per watt (20 watt)</td>
</tr>
<tr>
<td>Fully shielded fixture</td>
<td>Fully shielded fixture</td>
<td>Fully shielded fixture</td>
</tr>
<tr>
<td>$150 plus labor to install</td>
<td>$150 plus labor to install</td>
<td>$300 plus labor to install</td>
</tr>
<tr>
<td>Lamp life 10,000 hours</td>
<td>Lamp life 30,000 hours</td>
<td>Lamp life &gt;50,000 hours</td>
</tr>
<tr>
<td>Energy $31/year</td>
<td>Energy $20/year</td>
<td>Energy $9/year</td>
</tr>
</tbody>
</table>

---

![Metal Halide Light](image1.png)

![High Pressure Sodium Light](image2.png)

![LED Light](image3.png)
WALL PACK INCENTIVES

Wall Packs – replacing 70-400W HID

• HID to LED  $20-$60/fixture
• HID to Linear Fluorescent  $15-50/fixture
• HID to Induction  $15-$50/fixture
BOLLARDS

• Variety of styles to choose
• Many are fully shielded
• Replace metal halide bollards with 1/3 the watts
COMMENTARY ABOUT LIGHT COLOR OUTDOORS

People *don’t* like
- Very warm color (high pressure sodium)

People *don’t* like
- Very cold color (LED>5000K)

People *like*
- Warm color (2700-3000K)
- Neutral color (3500-4500K)

For environmental reasons the current evidence suggests narrow band amber LED or low pressure sodium in sensitive locations.
CANOPIES

Recessed canopy downlights
- Dark sky and neighbor friendly
- Standard light levels 50 fc
- Metal halide 250-400 watt
- LED 100-160 watt

Color Band
- Fluorescent 15 watt /sf
- LED 7.5 watt/sf (or less with color LED)
CANOPY INCENTIVES

• Fuel Canopy Incentives (Replacing 150-400W HID)
  – Linear Fluorescent, Induction, CMH $20-$50/fixture
  – LED $40-$60/fixture

• Q3 Special Offering:
  – LED Fuel Canopy – double the standard incentives for a limited time for 250 to 400 watt HID replacements
RETROFIT KITS

• An alternative to replacing fixtures
• For pole lights, canopy lights and almost all other types
• Requires ballast removal or disconnection
• Cost nearly the same as a new fixture
• Cooling of high wattage units requires a fan
• Most are >5000K and low CRI
SKYLIGHTS
SKYLIGHTS FOR BIG BOXES WORK

Major Brands Use Them
• Wal-Mart
• Costco
• Home Depot

Benefits
• Significant energy cost reduction of 35-40%
• Better color rendering
• Happier, healthier work force
• Higher light levels by day
TWO APPROACHES

Normal Big Box General Lighting Cost (24/7) = $1.05/sf

**Full Skylighting**
- 4-5% skylight to floor ratio
- Achieves 40-150 footcandles without electric lighting most days
- Dim or extinguish electric lighting
- Electric lighting 50-60 footcandles at night
- Annual electric cost ~70¢/sf (33% savings)
- Costs much more to build

**Hybrid Electric Skylighting**
- 2-3% skylight to floor ratio
- Electric lights operate 24/7 at 30-40 footcandles
- Daylighting adds 20-75 footcandles during the day
- Naturally adapts shoppers’ eyes
- Annual electric cost ~ 60¢/sf (43% savings)
- Costs more to build but less than full skylighting
LIGHTING CONTROLS
CONTROL SYSTEM OPTIONS

Old School

Exterior
• Lights off by day

Interior
• Lights off when not open
• Reduced lighting during stocking and cleaning

New School

Exterior
• Lights off by day
• Lights dim after hours

Interior
• Lights off when not open
• Reduced lighting during stocking and cleaning
• Reduced lighting when shoppers are not present