# Energy Efficient Lighting: Challenges and Solutions

New Construction and Retrofits

# Challenges

- **Reduce energy consumption**
  - **Improve efficiency**
  - **Shrink carbon footprint**
- Improve lighting quality
- Lower cooling requirements
- Provide for safety & security
- Increase productivity
- Fast payback
- Easy to install and/or upgrade
- User-friendly, simple & easy to operate
- Reliable & easy to maintain
- Signaling capability

# Reduce Energy Consumption, Save Energy:

In a 2013 NEMA/*Today's Facility Manager* survey, over 85% of the respondents rated "reduce energy usage and costs" as very important.

# THINK: LIGHTING SYSTEMS

# A Luminaire?

- "A luminaire is a device to produce, control and distribute light. It is a complete lighting unit consisting of one or more lamps and some or all the following components…"
  - Optical control devices
  - Sockets or mountings
  - Mechanical components for support
  - Components to start, operate, dim or otherwise control and maintain operation of the light sources

Source: *IES Lighting Handbook*, 10th Edition

# A Lighting System?

- A collection of luminaires and related lighting equipment installed in an application with consideration for:
  - Human comfort and visual needs
  - The physical environment
  - Energy consumption
  - Daylight integration
- Comprised of many components, including luminaires, sensors/controllers, light management systems, windows or skylights, etc.

# Applications

- Office spaces
- Retail Spaces
- Roadway & Area
- Taxi Pick-up
- Restaurant
- Manufacturing
- National monument
- Parking garages
- Health care facility
- Warehouse
- Classroom
- Car dealership
- Recreation center
- College/university

# Office Spaces: Panduit World Headquarters, Tinley Park, IL

Open office and collaborative workstations represent 90% of the office area. Virtually all employees have access to daylight and views. Corporate Headquarters: 280,000 sq. ft.

# Panduit Headquarters

**Challenges**

- Save lighting energy
- Reduce operating costs
- Increase building flexibility
- Minimize glare on work surfaces
- Reduce demand on heating and cooling systems

Payback in 5 years
Light energy savings: 25%
HVAC energy reduction: 5%

**Solutions**

- Occupancy/vacancy sensors
- Digitally addressable dimming ballasts
- Daylight sensors
- Automated shade adjustments
- Preset scene switches for personal control
- Light management system

# Office Spaces: Medical Mutual of Ohio, Historic Rose Building, Cleveland




Replace almost 3,000 aging T12 fluorescent, deep-cell parabolic luminaires with energy efficient upgrades.

# Medical Mutual of Ohio

**Challenges**

- Save on installation costs
- Avoid major construction and disruption
- Reduce energy consumption
- Provide for adequate light levels, but reduce glare

**Solutions**

- Installed retrofit T8 fluorescent, volumetric lighting kits with
- Step-dimming ballasts
- Installation was done at night
- Panel-mounted controls

Decreased annual energy usage from 1.9 million kilowatt hours to 906,000 kilowatt hours

# Retail Spaces: Boston Interiors, Stoughton, MA

A family-owned and operated furniture retailer sought to reduce operating costs, through lighting.

# Boston Interiors

**Challenges**

- Reduce energy consumption
- Improve lighting quality
- Reduce need for cooling
- Reduce carbon footprint

**Solutions**

- PAR38 LED retrofit lamps to replace 60-watt halogen lamps
- Note: less UV and IR output to cause discoloration and fading

Total energy and maintenance savings/year: $8,322
Energy savings/year: 48,315 kWh
Environmental savings/year: 61,022 lb $CO_2$

# Retail Spaces: Family Fare Supermarket, Wyoming, MI



Lower installation costs versus lower energy bills—you can have it both ways!

# Family Fare Supermarket

## Challenges

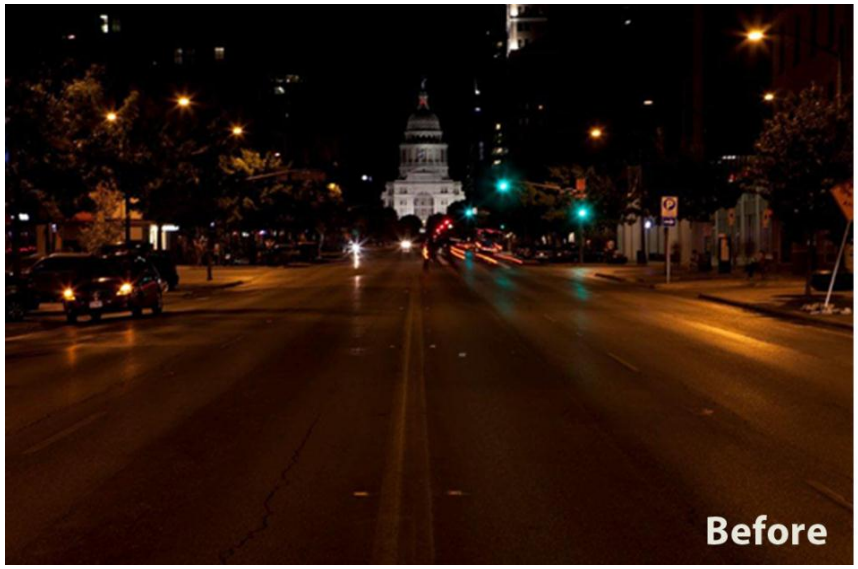
- Reduce energy consumption
- Save money on installation costs
- LEED Certification

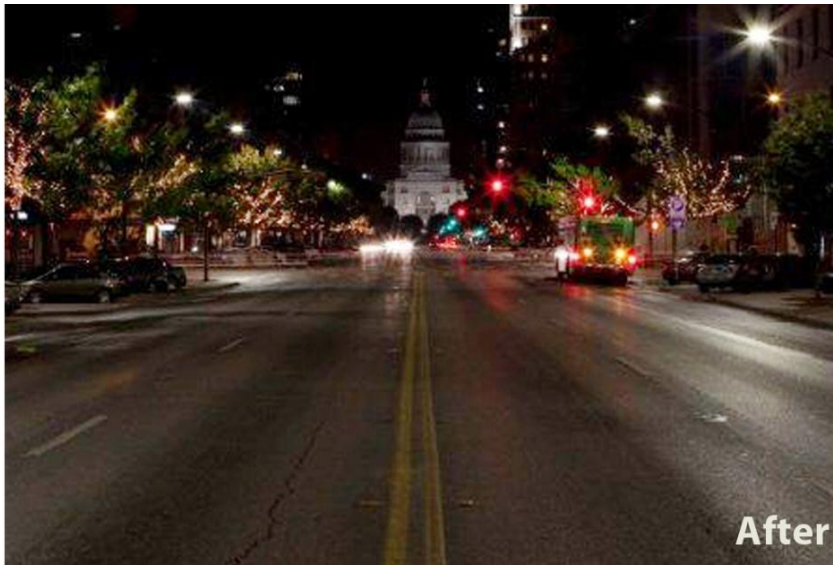
Cost savings of $5,000 to $10,000 on installation alone. Energy bill reduced by $3,500 a year.

## Solutions

- LED lighting in produce and other product cases
- 4-lamp luminaires with each ballast set to 90% power during the day
- At 11:00 p.m. the power level is reduced to 50%
- Ballasts that communicate with the control system over the power circuit—no additional wiring necessary

# Street Lighting: Austin, TX




The city is performing a major renovation of nearly 35,000 outdated high pressure sodium luminaires.

# Street Lighting: Austin, TX

**Challenges**

- Replace 35,000 outdated HPS luminaires
- Reduce energy consumption
- Ease of installation & maintenance
- Safety & security

**LED Luminaires: The Benefits**

- Easy to install with tool-less entry
- Last up to 60,000 hours—16 years when on 10 hours daily
- Uniform, warm, white light

30 to 70% energy savings over HID luminaires

# Unique: Lenox Hill Hospital, New York, NY



Lenox Hill Hospital was presented with a unique problem. It needed a solution to providing safe taxi pick-up service to hospital patients.

# Lenox Hill Hospital: Taxi Pick-up

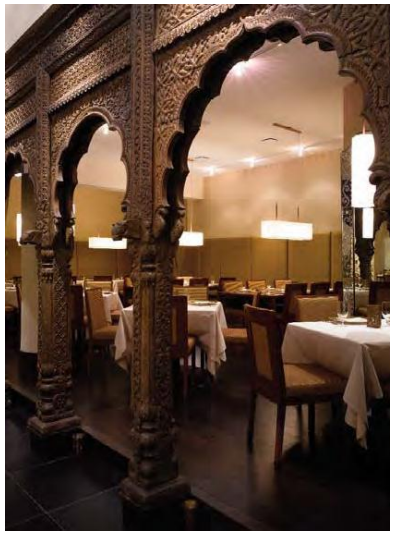
## Challenges

- On New York's bustling Lexington Avenue, getting a taxi can be a challenge
- At the hospital's front entrance is a high volume, narrow street
- Visibility was an issue
- Gridlock and safety were concerns

## Solutions

- Large, yellow LED "TAXI" signs were created, wired and mounted at the hospital entrance, visible to oncoming traffic
- The signs were assigned to RF 3-wire relay receivers and programmed to be controlled by RF handheld 4-button remote switches
- Each doorman presses his handheld remote to activate the sign

# Restaurant: Junoon, New York City

A modern restaurant in New York City to showcase the glories of centuries of Indian culture

# Junoon Restaurant

## Challenges

- A lighting system to control vast amounts of lighting to create an atmosphere
- Lighting to match the level of quality of the restaurants furnishings
- Reduce staff training
- Reduce energy consumption

Energy consumption reduced 40 to 70%
Lamp life increased from 2 to 10 years from dimming

## Solutions

- An automated controls system for the 145 seat restaurant
- Included time scheduling and different lighting scenes that could be varied according to the time of day and event
- Included automatic adjustment throughout the day to allow for sunlight
- Lights are dimmed 50% for lunch and 80% for dinner

# Manufacturing: Sunny Delight Beverages Co., Dayton, NJ

Sunny Delight distribution plants are large enough to ship to thousands of grocery stores world-wide.

# Sunny Delight Processing Plants

**Challenges**

- Save energy
- Reduce carbon footprint
- Increase light levels by 25%
- Short payback period
- Replace a 400-W metal halide system

**Solutions**

- Precision optics in 2-lamp T5HO luminaires

Annual energy savings: 62%
Payback: 7 months
Significant improvement in light levels

# Lava Beds National Monument


The national monument in northern California includes rugged desert terrain, historical sites and lava tube caves. Over 100,000 people visit it annually.

# Lava Beds National Monument

**Challenges**

- Reduce energy consumption
- Update administration facilities
- Reduce maintenance costs

**Solutions**

- Replace older linear fluorescent lamps with energy saving T8s
- Wireless occupancy sensing in common areas, offices, and restrooms

Energy use was reduced by 40%. That equated to 65,000 kWh of electricity savings or a $6,400 annual energy cost reduction.

# Parking Garages: Spectrum Health, Michigan

Spectrum Health was looking for ways to revamp the 1.25 million square feet of parking decks surrounding its facilities

# Spectrum Health

**Challenges**

- Improve security
- Reduce maintenance costs
- Save energy
- Reduce carbon footprint
- Long life to reduce maintenance

**Solutions**

- 1,500 LED garage fixtures
- With low glare optical and thermal management systems
- LED recessed 2’x2’ troffers in parking deck ceilings in entrance and in exit ways

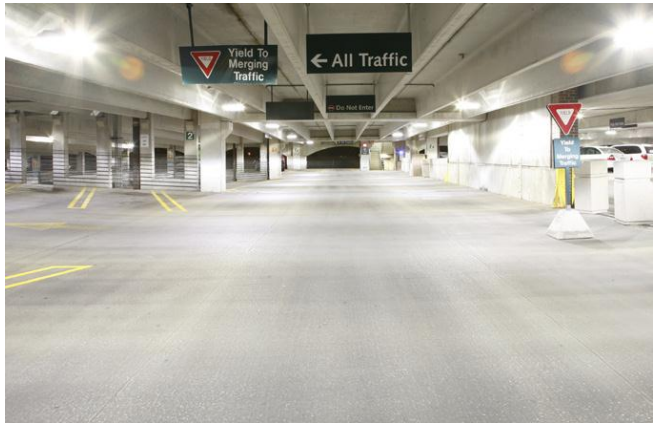
# Spectrum Health

**Operating Impact**

- $170,000 in annual energy savings
- 1.6 million kilowatt hours (kWhs) reduction in electricity use

**Environmental Impact**

- More than 965 metric tons per year $CO_2$ emissions eliminated
  - =261 new acres of trees
  - =186 cars off the road



# Health Care: Toronto General Hospital, R. Fraser Elliot Building

175,00 sq. ft. mixed use: Executive offices, administration, research facilities, food service, and emergency medical services

# Toronto General Hospital

**Challenges**

- Reduce energy consumption by 50%
- Payback from energy savings in less than five years
- Reduce lighting demand by 35%; provide for load shedding
- Maintain illuminance levels

**Solutions**

- Computerized control system
  - From centralized software application
  - Provides for personal control in office areas
- Retrofitted fixtures with electronic dimming ballasts
- Occupancy sensors
- Photo sensors
- PCs with personal control software

# Toronto General Hospital: Results

- Personal control
- Task tuning
- Daylight harvesting
- Smart time scheduling
- Occupancy sensing
- Variable load shedding

- Energy consumption reduction: 74%
- Annual energy cost reduction: $47,000
- Payback in 4 years
- 177 tons of $CO_2$ eliminated

# Warehouse: West Marine, Hall, SC

# West Marine

**Challenges**

- Reduce energy usage
- Reduce maintenance
- Quick payback

**Solutions**

- 2-lamp, 117 W, T5 fluorescent fixtures with an aisle beam system

Savings:
Annual energy savings: 70%
Demand reduction: 358 kW
Payback: < 13 months
Maintenance cost avoidance: $100,000+ (4,000 less lamps than other systems)

# A School Room: Alvin Junior High School, TX

A science class harvesting daylight in a windowless room

# Alvin Junior High School

**Challenges**

- Reduced energy consumption
- Increased student performance
- Glare free room

**Solutions**

- Tubular daylighting devices
- 3-lamp, T8 fluorescent, lensed troffers with
- Automatic dimming systems to adjust fluorescent light output to the amount of daylight
- Prismatic lenses on both the daylighting system and fluorescent luminaires

# Car Dealership: Camelback Toyota, Phoenix, AZ



AZ residents, especially during the summer, wait until sunset for outdoor activities to take advantage of cooler temperatures

# Camelback Toyota

**Challenges**

- Energy efficient systems
- Quality lighting
- Attractive selling environment

(1) 25 – 50% of the fixtures are turned off after mid-night saving ~$350/month. (2) The control system alternates lamps that burn, which boosts lamp and ballast life at least 25%.

**Solutions**

- 400-W and 750-W metal halide lighting fixtures
- A central control system for scheduling that continuously monitors the fixtures
- Photocontrols that communicate wirelessly to the central collection point

# Rec Center: Vogt Recreation Center, Philadelphia

Vogt Rec Center needed an upgrade from the old mercury vapor lamps installed decades ago

# Vogt Recreation Center

**Challenges**

- Reduce energy consumption
- Reduce maintenance costs
- Reduce AC costs

**Solutions**

- 4-lamp, 32-W, T8 fluorescent, high bay-low bay fixtures
- With program start ballasts

Reduced energy consumption by 84%
Energy and maintenance savings > $1,000/month
> 17,000 pounds of $CO_2$ are eliminated per year

# Weber State University, Ogden, UT

In 2010 the university launched an extensive, campus-wide energy efficiency program, covering over 2.5 million square feet of interior space.

# Weber State University

## Challenges

- Reduce energy consumption
- Lower maintenance costs
- Control light levels
- Improve occupant comfort—reduce glare

The university estimates a total energy savings of more than $220,000 annually, with more than $130,000 coming from controls.

## Solutions

- Replaced 32W T8s with standard ballasts w/28W T8 & hi efficiency programmable start ballasts in 2x4 troffers
- Lighting controls
  - Ceiling mounted occupancy sensors
  - Corner mounted occupancy sensors
  - Wall switches for manual-on or auto-on to 50%
  - Digital room controllers

# REFERENCES

# Definitions of a Luminaire and Lighting System

- NEMA LSD 62-2011, *Systems Approach for Lighting*
- Available at www.nema.org
- Search LSD 62

# Incentive Programs

National Summary Website, DSIRE:
http://www.dsireusa.org/


Nevada Information

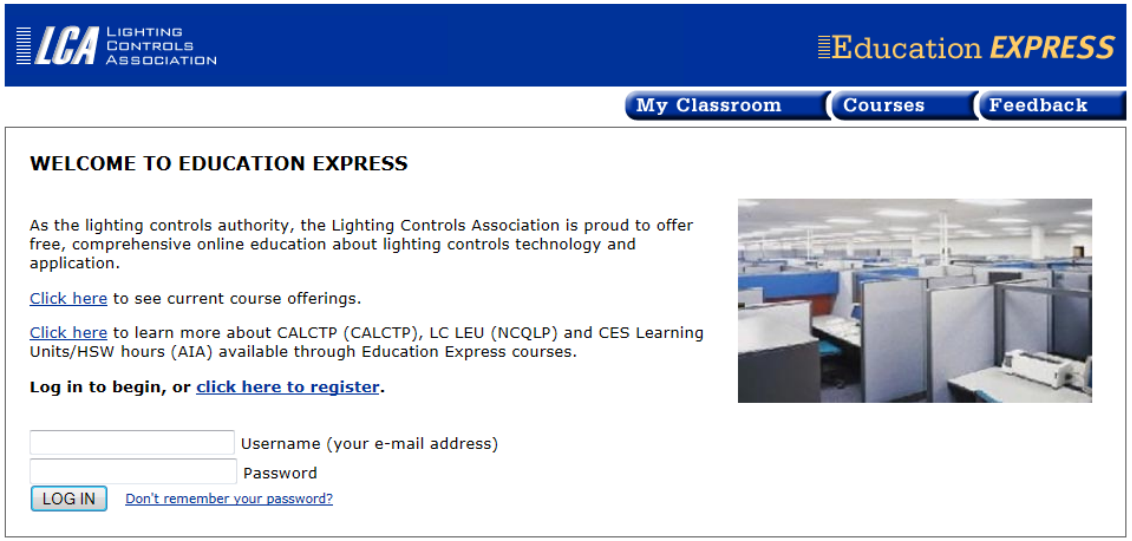
**Utility Rebate Program**

- NV Energy (Northern Nevada Gas) - Residential Energy Efficiency Rebate Program
- NV Energy (Northern Nevada Gas) - SureBet Business Energy Efficiency Rebate Program
- NV Energy (Northern Nevada) - Solar Hot Water Incentive Program
- NV Energy (Northern Nevada) - SureBet Business Energy Efficiency Rebate Program
- NV Energy (Southern Nevada) - Energy Plus Builder Efficiency Program
- NV Energy (Southern Nevada) - Residential Energy Efficiency Rebate Program
- NV Energy (Southern Nevada) - Solar Hot Water Incentive Program
- NV Energy (Southern Nevada) - SureBet Business Energy Efficiency Rebate Program
- NV Energy -Energy Smart Schools Program
- Southwest Gas Corporation - Commercial Energy Efficient Equipment Rebate Program
- Southwest Gas Corporation - Residential Energy Efficiency Rebate Program
- Southwest Gas Corporation - Smarter Greener Better Solar Water Heating Program

# Educational Information

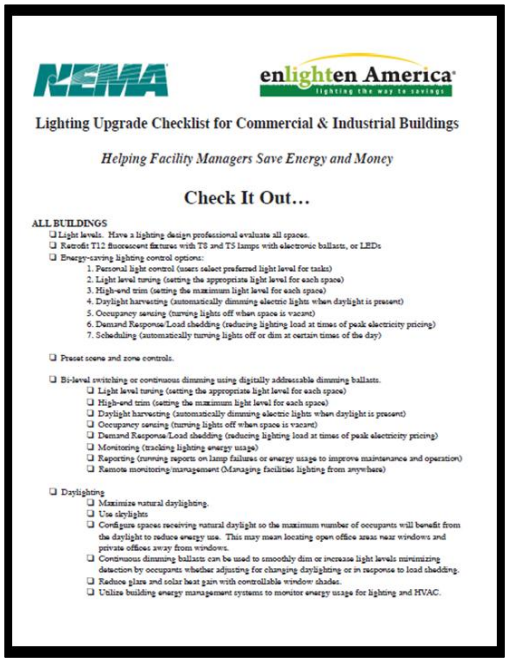
LIGHTING CONTROLS ASSOCIATION EDUCATION EXPRESS:

Offers free, comprehensive online education about lighting controls technology and application



# Information


February Issues of NEMA's *electroindustry* are dedicated to lighting and lighting applications



NEMA Lighting Upgrade Checklist

**Lighting Upgrade Checklist for Commercial & Industrial Buildings**

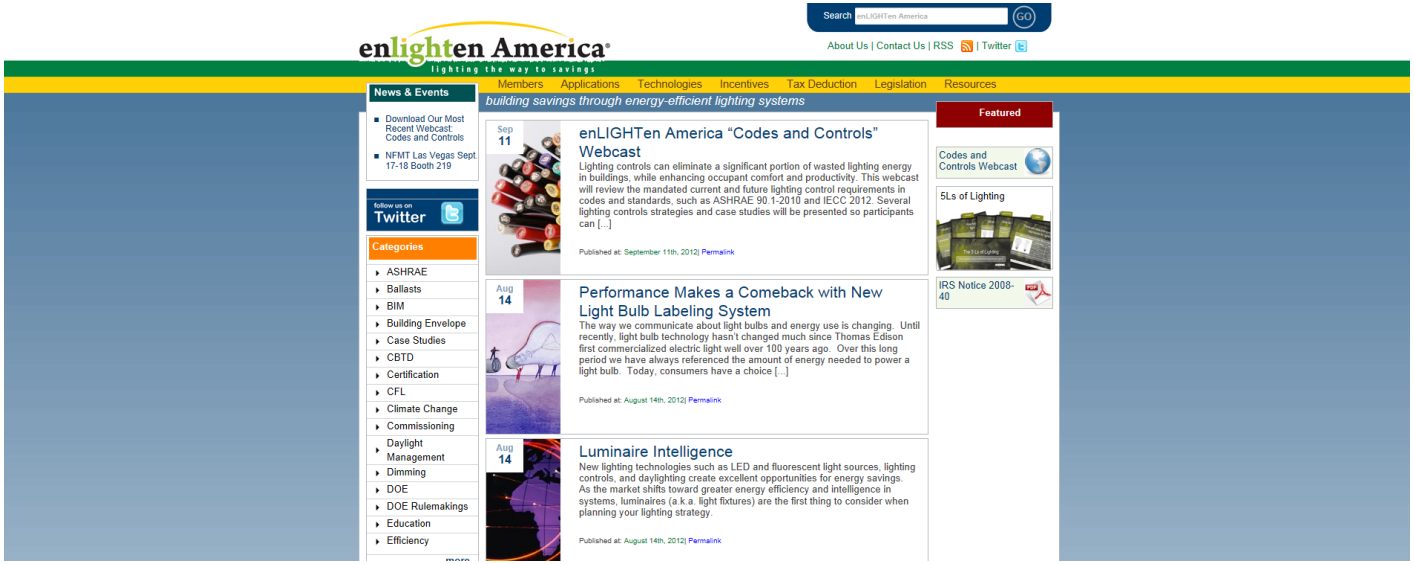
*Helping Facility Managers Save Energy and Money*

**Check It Out…**

ALL BUILDINGS

- ❑ Light levels. Have a lighting design professional evaluate all spaces.
- ❑ Retrofit T12 fluorescent fixtures with T8 and T5 lamps with electronic ballasts, or LEDs
- ❑ Energy-saving lighting control options:
  1. Personal light control (users select preferred light level for tasks)
  2. Light level tuning (setting the appropriate light level for each space)
  3. High-end trim (setting the maximum light level for each space)
  4. Daylight harvesting (automatically dimming electric lights when daylight is present)
  5. Occupancy sensing (turning lights off when space is vacant)
  6. Demand Response/Load shedding (reducing lighting load at times of peak electricity pricing)
  7. Scheduling (automatically turning lights off or dim at certain times of the day)
- ❑ Preset scene and zone controls.
- ❑ Bi-level switching or continuous dimming using digitally addressable dimming ballasts.
  - ❑ Light level tuning (setting the appropriate light level for each space)
  - ❑ High-end trim (setting the maximum light level for each space)
  - ❑ Daylight harvesting (automatically dimming electric lights when daylight is present)
  - ❑ Occupancy sensing (turning lights off when space is vacant)
  - ❑ Demand Response/Load shedding (reducing lighting load at times of peak electricity pricing)
  - ❑ Monitoring (tracking lighting energy usage)
  - ❑ Reporting (running reports on lamp failures or energy usage to improve maintenance and operation)
  - ❑ Remote monitoring/management (Managing facilities lighting from anywhere)
- ❑ Daylighting
  - ❑ Maximize natural daylighting.
  - ❑ Use skylights
  - ❑ Configure spaces receiving natural daylight so the maximum number of occupants will benefit from the daylight to reduce energy use. This may mean locating open office areas near windows and private offices away from windows.
  - ❑ Continuous dimming ballasts can be used to smoothly dim or increase light levels minimizing detection by occupants whether adjusting for changing daylighting or in response to load shedding.
  - ❑ Reduce glare and solar heat gain with controllable window shades.
  - ❑ Utilize building energy management systems to monitor energy usage for lighting and HVAC.

# Information

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Booth #219

# Contributing Companies

- Acuity Brands Lighting (9, 10, 33 – 36)
- Cooper Lighting (15, 16)
- Crestron (19, 20)
- Encelium (28 – 30)
- GE Lighting (25 – 27)
- Leviton Lighting and Energy Solutions (17, 18, 23, 24)
- LumenOptix (21, 22, 31, 32)
- Lutron Electronics Co., Inc. (7, 8)
- Magnaray International (37, 38)
- OSRAM SYLVANIA (11, 12)
- Universal Lighting Technologies (13, 14)
- WattStopper (39, 40)

(Slide numbers in parentheses)