

Implementing Lighting Management Technologies and Practices to Drive Building Efficiency

NEMA Enlighten America 2011





- 1. Understand the latest lighting control technologies
- 2. Learn how to reach energy and sustainability goals through lighting management
- 3. Learn from case studies on how occupant satisfaction and energy savings was achieved through lighting controls









Why Lighting Management is Important



- Saving energy
- Reducing building operating costs
- Complying with energy codes
- Meeting sustainable design goals (i.e., LEED)
- Enhancing occupant comfort and productivity





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Saving Energy





- Buildings are over-lighted
- Daylight is ignored
- Lights are left On
- Lights are mostly operated at Full-On



What's wrong here?

"Most buildings don't deliver the right amount of light where and when it is needed. Lighting is often set at a 'worst case' level, which is usually higher than desired." -- Stephen Selkowicz LBNL





Reduce operating expenses

- Reduce energy usage and peak demand charges (i.e. energy costs)
- Reduce "churn" costs when renovating/reallocating space
- Monitoring of lighting power

Capitalize on tax deductions and utility incentives

- EPAct
- Utility Rebates (<u>www.dsireusa.org</u>)

Help your top line revenues

- Support higher tenant retention rates and reduce vacancies
- Generate revenue through demand response contracts







Commercial State Energy Code Status AS OF MARCH 1, 2011 70% adoption of codes 90.1-1999 or better NH VT MA R CT NJ DE MD DC meets or exceeds ASHRAE Standard 90.1-2007 or equivalent meets or exceeds ASHRAE Standard 90.1-2004 or equivalent meets or exceeds ASHRAE Standard 90.1-1999-2001 or equivalent no statewide code or precedes ASHRAE Standard 90.1-1999 PR V state has adopted a new code to MP be effective at a later date NOTE: P Dedicated to the adoption, implementation, and advancement of building energy codes These maps reflect only mandatory statewide codes currently in effect. Get all the most up-to-date code status maps and other valuable resources at www.bcap-ocean.org





Energy Code – Lighting Control Requirements

- Area control
- Automatic lighting shut-off
- Daylight control
- Multi-level lighting / Light reduction control
- Exterior lighting control
- Manual-on control
- Stairwell lighting control



• Plug load control (i.e. Automatic-off of task lights, and other plug loads)







Meeting Sustainable Design Goals -- LEED®

Category	Credit
Sustainable Sites	 Light Pollution Reduction (1 pt)
Energy & Atmosphere	 Commissioning (2 pts) Energy Performance (1-19 pts) Measurement and Verification (3 pts)
Materials & Resources	 Recycled Content (1-2 pts)
Indoor Environmental Quality	 Controllability of Systems (1 pt) Daylight & Views (2 pts)
Innovation in Design	 Innovation in Design(1-4 pts) LEED-AP(1 pt)
Regional Priority	 Varies by zip code (1-4 pts)

Lighting controls and services provide solutions that contribute to up to 40 of the 110 possible points in LEED-NC 2009.





Enhancing Comfort/Productivity from Lighting Controls

Light Right Consortium

 Occupants maintained productivity when they had personal control of their lighting

Heschong Mahone Studies

- Call center workers processed calls 6-12% faster.
- Office workers performed 10-25% better on tests of mental function and memory recall.
- Retailer reported a maximum 40% increase in sales.
- Students progressed 20% faster on math tests and 26% on reading tests.



Light Right Consortium



How Lighting Control Saves Energy

- 1. Reduces operating hours (switching off)
- 2. Reduce watts used when lights are on (dimming)
- 3. Reduces cooling load
- Maximizes effective use of sunlight







Lighting Management Strategies



Scheduling: Lights automatically turn off or are dimmed at certain times of the day or based on sunrise or sunset.



Occupancy/Vacancy Sensing: Automatically turning lights off when people vacate the space.



Multi-level Lighting/Dimming: Proving users one or more light levels than full-on and full-off.



Daylight Harvesting: Automatically adjust light levels based on the amount of daylight in the space.





Lighting Management Strategies



High end trim/Tuning: Set target light level based on occupant requirements in the space.



Personal Light Control: Allow users in the space to select the correct light levels for the desired task.



Controllable Window Shades: Allows users to control daylight for reduced solar heat gain and glare.



Demand Response: Reducing lighting load at times of peak electricity pricing.



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Plug-load Control: Automatically turning task lighting and other plug loads off when they are not needed.





Scheduling:

Lights automatically turn off or are dimmed at certain times of the day or based on sunrise or sunset.

- •Programmable Lighting Relay Panels
- •Building Automation Systems
- •Controllable Breakers
- •Energy Savings Potential 10% 35%













*	
Occupied: On	Vacant: Off

Occupancy/Vacancy Sensing:

Automatically turning lights off when people vacate the space

- •Auto-On 50%/Auto-Off
- Manual-On/Auto-Off
- Multi-level
- Technologies
 - Passive Infra-red
 - Ultrasonic
 - Multi-Technology
- •Wired and Wireless
- Energy Savings Potential 20-80%











Occupancy Sensor Savings

Occupancy area	Energy savings
Private office	13-50%
Classroom	40-46%
Conference room	22-65%
Restrooms	30-90%
Corridors	30-80%
Storage areas	45-80%

Source: Lighting Research Center





Real world example – Bronners

Customer:

Bronner's Christmas Wonderland is one of the world's largest suppliers of Christmas items.

Problem:

Reduce energy consumption for lighting in warehouse areas

Strategy:

Occupancy sensing in warehouse area using fixture mounted high bay occupancy sensors

<u>Results:</u>

At the end of the 120 day cycle, the aisles without the sensor the lights were on for 1,267.9 hours, the aisles with the sensor were on for 123.4 hours, that is a savings of <u>89.73%</u>. The entire building has been retrofitted with occupancy sensors









Daylighting Control



Daylight Harvesting:

Automatically adjust light levels based on the amount of daylight in the space

- •Daylight dimming vs. daylight switching
- •Wired or wireless
- •Energy Savings Potential 10% to 80%









Case Study Example The Plaza at PPL Center

Low Energy Design Features:

- South Façade sun screening
 - 3' deep louvers at every level
 - High performance solar control glass
- Thermal control glass on north facades
- Heat recovery ventilation
- Optimized HVAC systems with variable speed drives
- Occupant and daylight responsive lighting controls
- Over 30% improvement beyond ASHRAE 90.1





The Plaza at PPL Center

Advanced lighting controls:

- Open plan office areas
 - South & North open office areas divided into three control zones:
 - Perimeter (15' from façade)
 - Middle (15-30' from façade)
 - Interior (30' to core)

Perimeter offices, conference rooms

- Vacancy switches/sensors to switch lights on/off
- Daylight sensor to set electric light levels based on available daylight

Interior offices, copy rooms, restrooms

 Vacancy switches/sensors to switch lights on/off



Perimeter and Middle zones daylighting controls Interior zone - On/off time clock control





The Plaza at PPL Center







<u>Multi-level Lighting Control</u>: Providing users one or more light levels than full-on and full-off.

- Controlling all lamps or luminaires (i.e. dimming)
- Dual switching of alternate rows of luminaires, alternate luminaires or lamps
- Switching middle lamp luminaires independently from the outer lamps
- Switching or dimming each luminaire or each lamp (i.e. personal control)
- Energy savings potential: 8% to 80%









High end Trim/Tuning: Set target light level based on occupant requirements in the space.

- Existing spaces are over-illuminated.
- 20-25% reduction in lighting levels is undetectable by the human eye.
- Lower light levels might be preferred
- The reflectance's within a space may allow for lower light levels
- Lumen depreciation--Light sources reduce their lumen output over time. Adjust for this by reducing light output initially and increase it over the life of the lamp.
- Allows for future flexibility (easier to tune lights that add or remove fixtures)
- Energy savings potential: 25%







Shade Control



Controllable Window Shades:

Allows users to control daylight for reduced solar heat gain and glare.

- Automated or manual
- •Block glare
- •Preserve view
- •Reduce solar heat gain
- •Daytime: 10 to 30% reduction in cooling load
- •Evening: 1-3% reduction in heating load









Personal Control



Personal Light Control:

Allow users in the space to select the correct light levels for the desired task.







Plug Load Control



- Extends occupancy-based or time-based control to desktop loads
 - Computer monitors
 - Task lighting
 - Fans
 - Speakers...







Emerging Technologies

Digital and Wireless Lighting Controls







The Value of Digital

What is digital lighting control?

- De-Centralized control system that incorporates occupancy sensing, daylight harvesting, scheduling, switching and/or dimming of lightings, software based programming and personal lighting control options
- Every device in every zone or network is digitally addressable
- Systems have the intelligence to make their own control decisions
- All devices are connected with low voltage wiring
- Devices can be wired using 'daisy chain" instead of 'home run" design









The Value of Digital

Benefits of Digital Lighting Control

Easy to Design

- Topology free.
- Easily create a lighting design with various levels of lighting control including switching, distributed dimming, occupancy sensing, and daylight harvesting anywhere—from a single room to an entire campus of buildings.

Easy to Install

 All components including occupancy sensors, photocells, relays, switches, dimmers, and controllers – are interconnected using the same wiring throughout the entire system using the daisy chain technique.

- Easy Energy Savings

 Cost-effectively save as much as 40% by combining switching, distributed dimming, occupancy sensing, and daylight harvesting energy saving technologies in one integrated system.









The Value of Digital

Components in a digital lighting control system

Conference
 Video
 Meeting
 AV
 Or

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Layout: Classroom System

- Topology Free Wiring
- No "home run" wiring needed-all components are "daisy chained"
- Digital components connected with low voltage wiring for reduced materials and labor cost
- Modifications and expansion are easy and cost effective







Graphical User Interface Allows Real Time Total Building Lighting

The current area selected is: The New York Times\15th Flor	Shedding Diagnostics or/North/Training 104		
You are viewing: 🔞 The New York Times\Tower\15th Flo	oor		Switch to Tabular View
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lighting the way to say



Case Study – The NYT Building

"We designed our building to use 1.28 watts per square foot of lighting power...with light management it's using only 0.39 W/sq.ft. on average — that's about 70% less."

Strategy:

- Light level tuning
- Daylight harvesting
- Occupancy sensing
- Monitoring

Results:

- 70% lighting energy saved
- Over \$1 per square foot per year saved



Glenn Hughes Director of Construction The New York Times Co.





Case Study – The NYT Building







Case Study – The NYT Building

Lighting Power Usage 2009 The New York Times Building







Wireless Lighting Control

"I do not think that the wireless waves I have discovered will have any practical application"

- Heinrich Rudolf Hertz, German physicist
- First to broadcast and receive radio waves.
- The hertz (Hz), a unit of frequency in cycles per second, is named for him.







- It's all about the money...
- Labor savings of up to 75% over hardwired
- Installs in ¼ the time of hardwired
- Eliminates need for dedicated control wiring, switch legs, traveler wires and other materials
- 50% installed cost savings over hardwired
- Ideal retrofit solution
 - No damage to walls or ceilings
 - Little to no disruption to operations







Primary Wireless Technologies

- Z Wave
 - Residential mesh network of devices
 - Battery or hardwire power
- ZigBee
 - Commercial mesh network of devices
 - Battery or hardwire power
- EnOcean
 - Commercial & Residential
 - Self Powered
- Proprietary systems
 - Varies depending on manufacture











Wireless Applications

- Commercial Office Space
- Manufacturing and Warehouse
- Hospitality
- Healthcare
- Education
- Residential Care Facility
- Wireless is the ideal lighting control solution for many retrofit applications





Case Study – Wireless Workers Compensation Fund

The Challenge:

Provide a zoned area daylight harvesting system in all open areas of the facility that responds to both day lighting in the space and occupancy sensors. The challenge was that the mechanical HVAC system installation included disc diffusers that provide for large amounts of air to move across the ceiling at high volume. This interfered with the sensing capability of the ultrasonic occupancy sensors used for lighting control in the large open office spaces. This issue was not recognized until the building was occupied by the owner after construction was completed.

Solution:

enlighten America

Wireless infrared occupancy sensors were used to replace the hardwired ultrasonic sensors without the need to have major rewiring done. Installation was done in one weekend with minimal labor cost and no disruption to the workspace.





Case Study – Wireless Workers Compensation Fund

Results:

The system functioned as required by the design team and the owner. Using the existing location for hardwired devices and them pairing that with the wireless devices resulted in minimal interruption to the owner. Substantially reduced installation cost resulted from the use of wireless devices. This allowed for energy savings from both daylight harvesting and on/off control of the facilities lighting. The facility was awarded LEED Gold status, up from the original LEED Silver, in part due to the extra points for using wireless products.









National Electrical Manufacturers Association

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Lighting Systems Division



www.nemasavesenergy.org

Your source for energy efficient, sustainable lighting solutions.







- Start today by going to our website www.nemasavesenergy.org
- Ask us how we can help you
- Set up future meetings with us to drill into the details
- Create a time line / plan to accomplish your goals
- Execute together





Questions?



