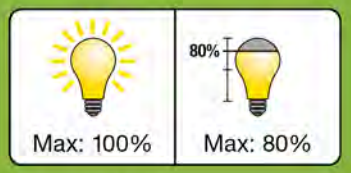
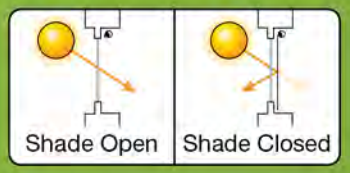
Lighting Control Design Workshop

Strategies, Standards & New Technologies



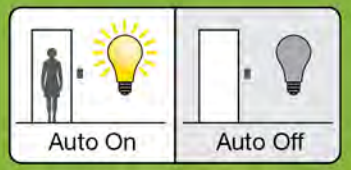
High-end trim



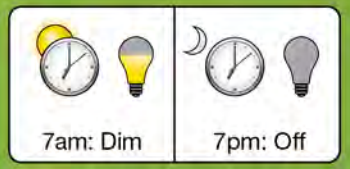
Controllable window shading

Daylight harvesting

Demand response

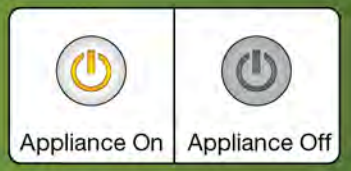


Occupancy/vacancy sensing



Scheduling

Personal dimming control



Appliance Control

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Our founder, our company

- Our founder, Joel Spira, invented the first solid state dimmer switch in 1959
- Founded Lutron Electronics in 1961
- Today, we are the industry expert and global leader of light control with over 200 US Patents

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Noteworthy projects

The White House, Washington, D.C.

Statue of Liberty, New York, NY

Guggenheim Museum, Bilbao, Spain

St. Paul's Cathedral - London

Bank of China HQs, Beijing, China

New York Times, New York, NY

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Global Presence

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Why Lighting Controls?

Quantifiable

- Tuning / Dimming
- Occupant Sensing
- Day-lighting
- Personal Control
- HVAC Savings
- Window Shading
- Demand Response
- Plug Load Control

Other Benefits

- Productivity
- Maintenance
- Sustainability/LEED
- Property Value
- Flexibility

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ENERGY.GOV
Office of Energy Efficiency & Renewable Energy

Search Energy.gov

SERVICES EFFICIENCY RENEWABLES TRANSPORTATION ABOUT US OFFICES >

Promising Technologies List

The Federal Energy Management Program's (FEMP) Promising Technologies List provides information about promising new and underutilized energy-saving technologies available for Federal and commercial building sector deployment. To identify promising technologies, FEMP performed a rigorous analysis with the Prioritization Tool, an analytical tool developed by the Building Technologies Office (BTO). The BTO Prioritization Tool evaluates the energy savings potential of energy efficiency measures, and takes into account cost-effectiveness. FEMP has used the Prioritization Tool to identify 20 technologies with the largest potential for cost-effective energy savings if deployed throughout the Federal Sector.

For More information about the BTO Prioritization Tool, visit
http://energy.gov/eere/buildings/prioritization-tool

http://energy.gov/sites/prod/files/2015/01/f19/2014Promising_Technologies.pdf.

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Promising Technologies

Lighting
- Wireless Lighting Occupancy Sensors
- Parabolic Aluminized Reflector (PAR) Light-Emitting Diodes (LEDs)
- Parking Lot LEDs with Controls
- High Bay LEDs
- Retrofit Lights to LEDs in Refrigerators

Heating & Cooling
- Ground Source Heat Pumps
- High Efficiency Rooftop Units (RTUs)
- Magnetic Bearing Variable Speed Centrifugal Chillers
- Condensing Gas Boilers

Ventilation
- Demand Control Ventilation (DCV)
- Constant Air Volume (CAV) to Variable Air Volume (VAV) Ventilation
- Energy Recovery Ventilation (ERV)

Water Heating
- Condensing Gas Water Heaters
- Heat Pump Water Heaters
- Tankless Gas Water Heater s

Windows and Envelope
- R-5 Window Replacements
- Cool Roofs (.75 Solar Reflectance)
- Cool Paints for Exterior Walls

Other
- Ozone Laundry Systems for Multi-Clothes Washers
- Auto Sash Fume Hoods

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Wireless Lighting Occupancy Sensors

Occupancy sensors and controls detect human presence, and modulate light settings accordingly. When there is no human presence detected, the system can dim or turn off lights. This technology ensures that lights are not used when there are no occupants present, which can lead to significant energy savings.

- Site Energy Savings Potential for the Federal Sector (Trillion-BTUs) — **6.9**
- Avoided Carbon Dioxide Emissions Potential (Million-Tons) — **1.2**

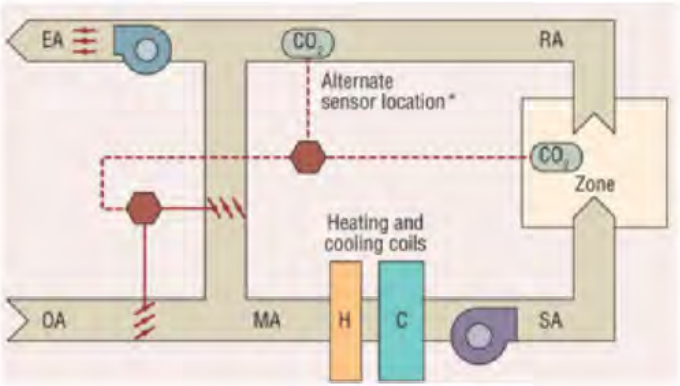
Implementation of this measure across the Federal Sector would provide energy savings ***equivalent to the site energy consumption of 5,000 average sized office buildings****.*

Technology Considerations

- There are multiple suppliers
- Optimal for buildings with long operating hours
- Applicable to any building type and location
- Has been shown to reduce lighting energy consumption 27% to 63%

Demand Control Ventilation (DCV)

DCV measures carbon dioxide concentrations in return air or other strategies to measure occupancy, and accurately matches the ventilation requirement. This system reduces ventilation when spaces are vacant or at lower than peak occupancy. When ventilation is reduced, energy savings are accrued because it is not necessary to heat, cool, or dehumidify as much outside air.



- Site Energy Savings Potential for the Federal Sector (Trillion-BTUs) — **14.4**
- Avoided Carbon Dioxide Emissions Potential (Million-Tons) — **1.4**

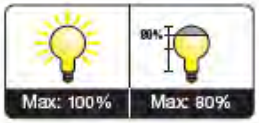
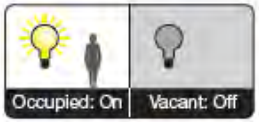
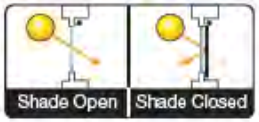
Implementation of this measure across the Federal Sector would provide energy savings ***equivalent to the site energy consumption of 10,400 average sized office buildings****.*

Technology Considerations

- There are multiple suppliers
- Applicable to all building types and locations, though savings will vary according to building characteristics and climate
- Has been shown to reduce energy costs 38% in an office building

Energy Saving Strategies

60% Energy Savings

Strategy		Potential savings
	**High-end Trim** sets the maximum light level based on customer requirements in each space.[7]	20% Lighting
	**Occupancy/vacancy sensing** turns lights on when occupants are in a space and off when people vacate the space.[8]	15% Lighting
	**Daylight harvesting** dims electric lights when daylight is available to light the space.[9]	15% Lighting
	**Personal dimming control** gives occupants the ability to set the light level.[10]	10% Lighting
	**Controllable window shading** moves shades to reduce glare and solar heat gain.[11]	10% Air Conditioning
	**Scheduling** provides scheduled changes in light levels based on time of day.[12]	Variable
	**Demand response** automatically reduces lighting loads during peak electricity usage times.	Variable

Total Light Management - Case Study

New York Times

•Measured LPD, Lighting Power Density

– Designed at 1.28 W/ft2

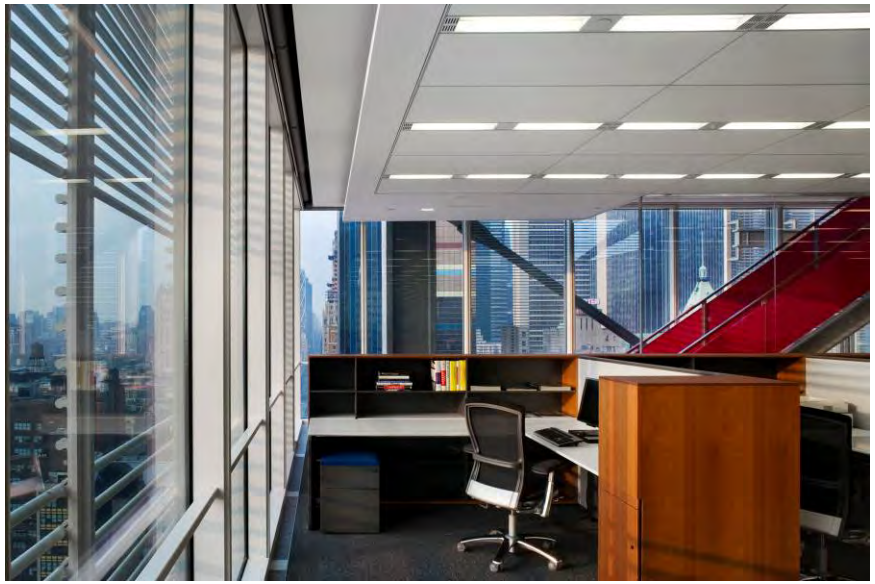
– Operating at 0.36 W/ft2

•**Seasonal data reflects yearly lighting energy savings of 72%**

•Annual Energy Savings:

5,220 MWh

10.7 kWh/ft^2



"We designed our building to use 1.28 watts per square foot of lighting power," Hughes said. "With Quantum, The New York Times Company is using only 0.36"

"Glenn Hughes, Director of Construction for the New York Times Building"

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Typical Energy Savings

Occupancy Sensing Savings

Private Office	30%
Open Office	15%
Conference Rooms	40%
Hallways/Atriums	25%
Utility Rooms	70%
Bathrooms	50%

Detailed Occ Sensing Energy Saving Calculator	
Total Normal Hours	14.0 hrs
Lunch Hour	1 hrs
% of occupant leave desk for lunch	50%
Average office hours	10 hrs
Average MISC away time	2 hrs
Total Modeled Unoccupied Time	**6.5 hrs**
Time out period	8 mins
Total Time out period	24 mins
Max Occupancy Sensing Savings	43.57%
Chance of occupants leaving lights on	70.00%
Expected Occ Sensing Savings	**30.50%**

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Data from the U.S. Environmental Protection Agency

What data exists to support 15%-70% 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%

Typical Energy Savings

Daylight Savings

South Facing Windows	40%
West and East Facing	30%
North Facing Windows	20%

Daylighting Energy Saving Calculator			
# of Rainy days in a year:			90
			http://www.weatherbase.com/
Maximum Daylight Harvest			0.645792564
		% Reduction in Artifical Light	# of Fixtures in Daylight Zone
Daylit Zone	Closest to Window		
	1	80%	10
	2	65%	10
	3	40%	10
	4	0%	0
	Furthest from Window		
		Side Facing Discount	0%
		Expected Daylighting Savings	39.82%

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Daylight Harvesting

What data exists to support 20%-40% savings?

- 51% lighting energy savings

Sidelighting Photocontrols Field Study. Heschong Mahone, 2003

- 24% savings in open and private offices

The Potential Simplified Concepts for Daylight Harvesting. Lighting Research Center; http://www.lrc.rpi.edu/programs/daylighting/pdf/simplifiedConcepts.pdf

- 40% lighting energy savings

Sidelighting – Daylighting Requirements for Sidelit Areas near Windows. July 2006, PG&E

Typical Energy Savings

High-end Tuning/Dimming Savings

High End Trim	20%	LPD < 1 W/Ft2	10%
Personal Control	10%	LPD < 1.5 W/Ft2	20%
Light Level Tuning	20%	LPD < 2 W/Ft2	40+%

Plug Loads

Total of All Product Stand-by Loads

- 100% during After hours
- % of Occupancy during Normal Hours

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Light Control Strategies that Save Energy

Personal Dimming Control: 10%

What data exists to support 10% savings?

- Light Right Consortium and National Research Council of Canada – 15% energy savings with a sample size of over 500 people
- Individual Lighting Control: Task Performance Mood & Illuminance: Lighting Research Center.
- http://www.lrc.rpi.edu/resources/pdf/67-1999.pdf : 35-42% savings

UFC 3-530-01
22 August 2006
Including Change 2, 1 September 2012

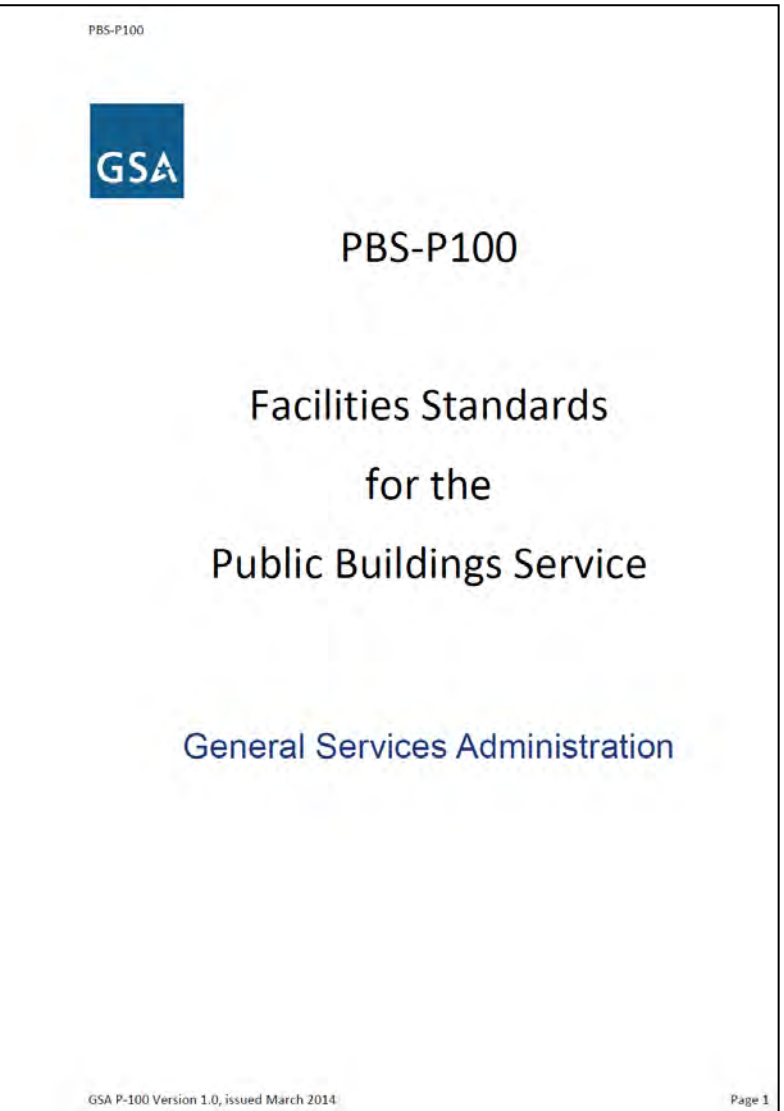
UNIFIED FACILITIES CRITERIA (UFC)

Design: Interior, Exterior Lighting and Controls

Table 2-4. Lighting Control Energy Savings Examples by Application and Control Type[5]

Space Type	Controls Type	Lighting Energy Savings (Demonstrated in Research or Estimated as Potential)	Study Reference
Private Office	Occupancy sensor	38%	*An Analysis of the Energy and Cost Savings Potential of Occupancy Sensors for Commercial Lighting Systems*, Lighting Research Center/EPA, August 2000.
	Multilevel switching	22%	*Lighting Controls Effectiveness Assessment*, ADM Associates for Heschong Mahone Group, May 2002.
	Manual dimming	6-9%	*Occupant Use of Manual Lighting Controls in Private Offices*, IESNA Paper #34, Lighting Research Center.
	Daylight harvesting (sidelighting)	50% (manual blinds) to 70% (optimally used manual blinds or automatic shading system)	"Effect of interior design on the daylight availability in open plan offices", by Reinhart, CF, National Research Council of Canada, Internal Report NRCC-45374, 2002.
Open Office	Occupancy sensors	35%	National Research Council study on integrated lighting controls in open office, 2007.
	Multilevel switching	16%	*Lighting Controls Effectiveness Assessment*, ADM Associates for Heschong Mahone Group, May 2002.
	Daylight harvesting (sidelighting)	40%	"Effect of interior design on the daylight availability in open plan offices", by Reinhart, CF, National Research Council of Canada, Internal Report NRCC-45374, 2002.
	Personal dimming control	11%	National Research Council study on integrated lighting controls in open office, 2007.
Classroom	Occupancy sensor	55%	*An Analysis of the Energy and Cost Savings Potential of Occupancy Sensors for Commercial Lighting Systems*, Lighting Research Center/EPA, August 2000.
	Multilevel switching	8%	*Lighting Controls Effectiveness Assessment*, ADM Associates for Heschong Mahone Group, May 2002.
	Daylight harvesting (sidelighting)	50%	*Sidelighting Photocontrols Field Study*, Heschong Mahone Group, 2003.

GSA PBS-P100



6.3.2.5 Lighting Controls

Control systems must be compatible with lamps, light sources, ballasts and lamps.

Lighting controls must use individual luminaire control, such as DALI equivalent. Ambient lighting must be adjusted per daylight availability, occupant/vacancy, and other BAS signals, such as demand response. Task and personalized ambient lighting must be adjusted per occupancy/vacancy and personal dimming.

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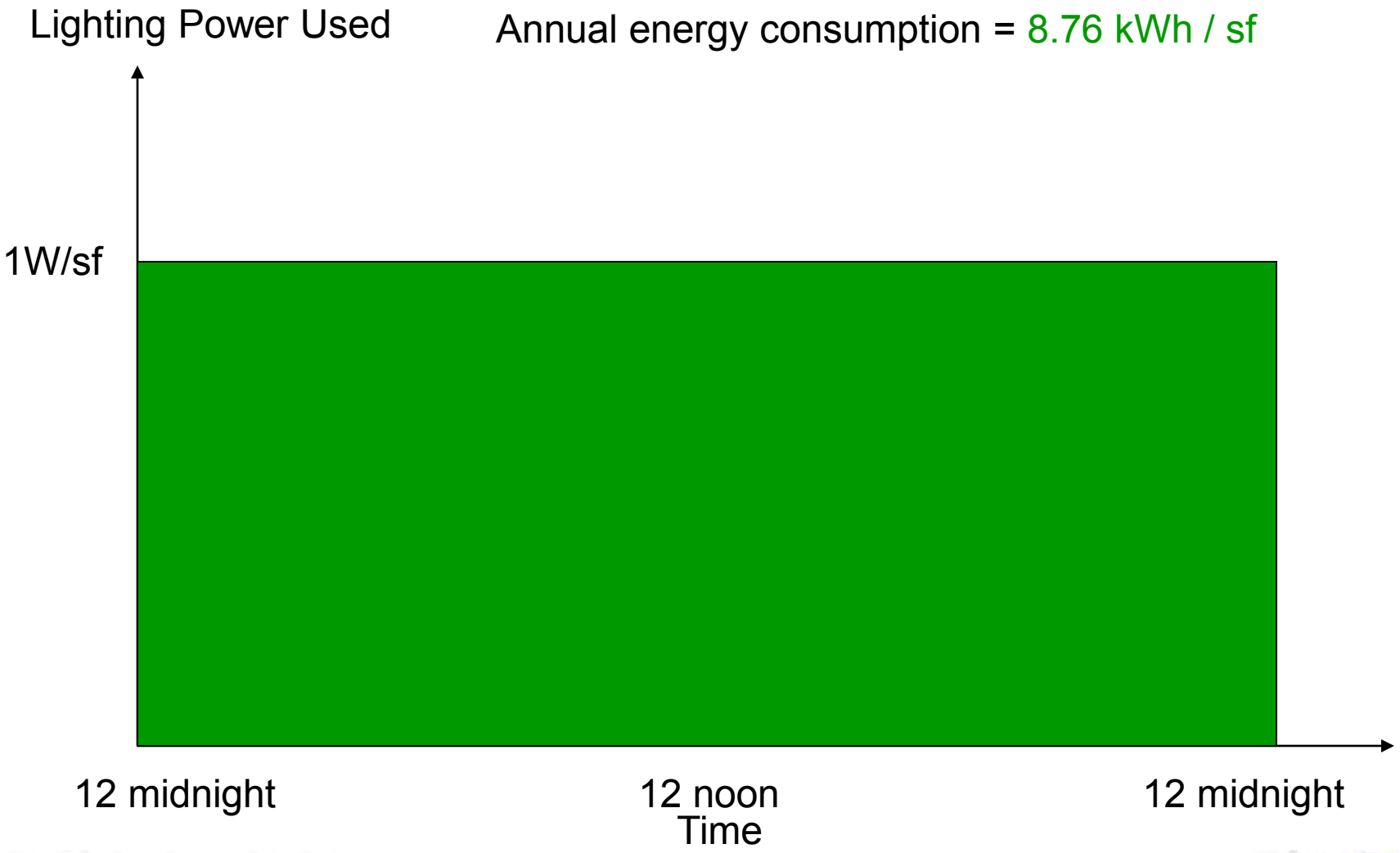
Office Building Example – Lighting Energy



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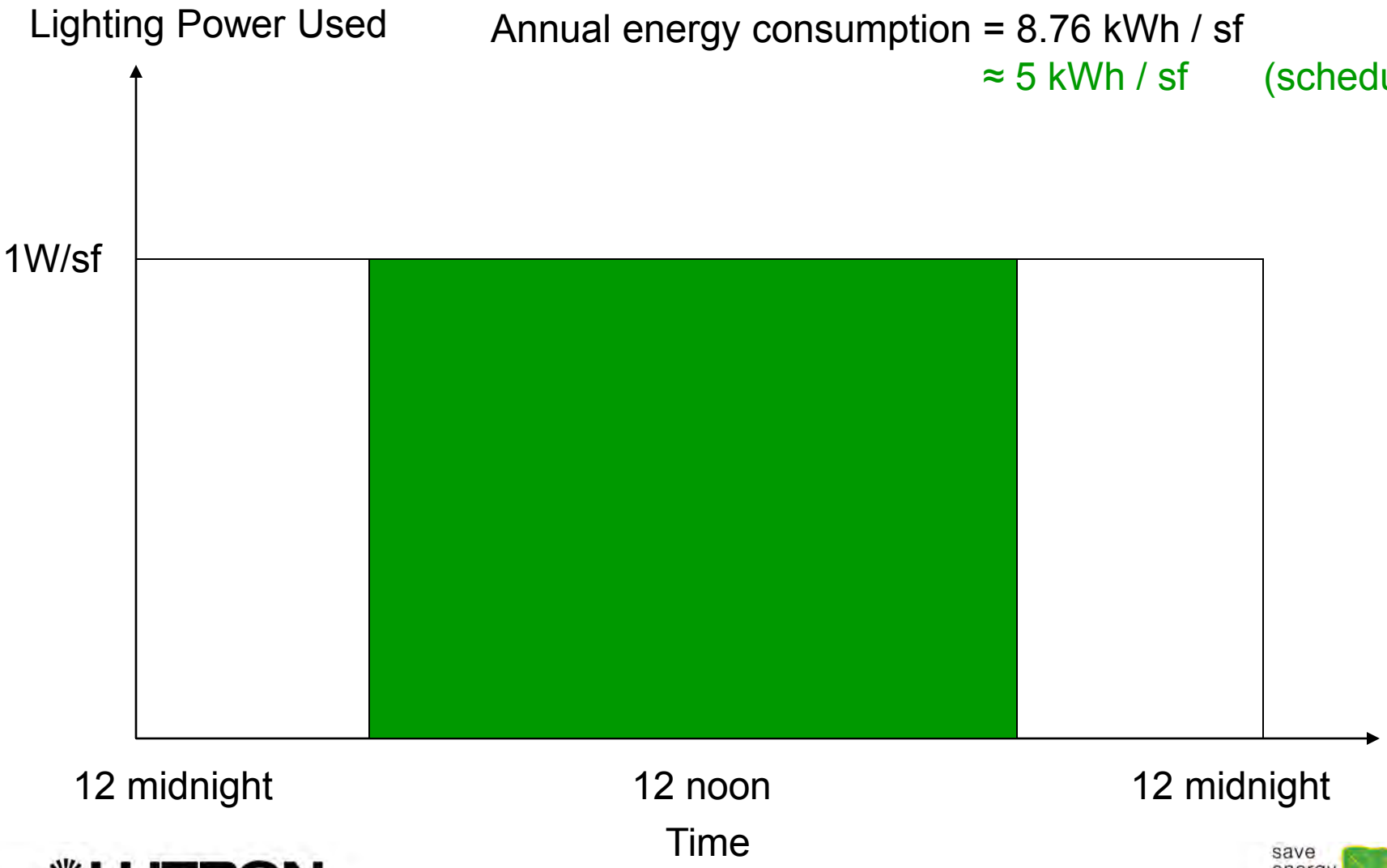
Office Building Example – Lighting Energy



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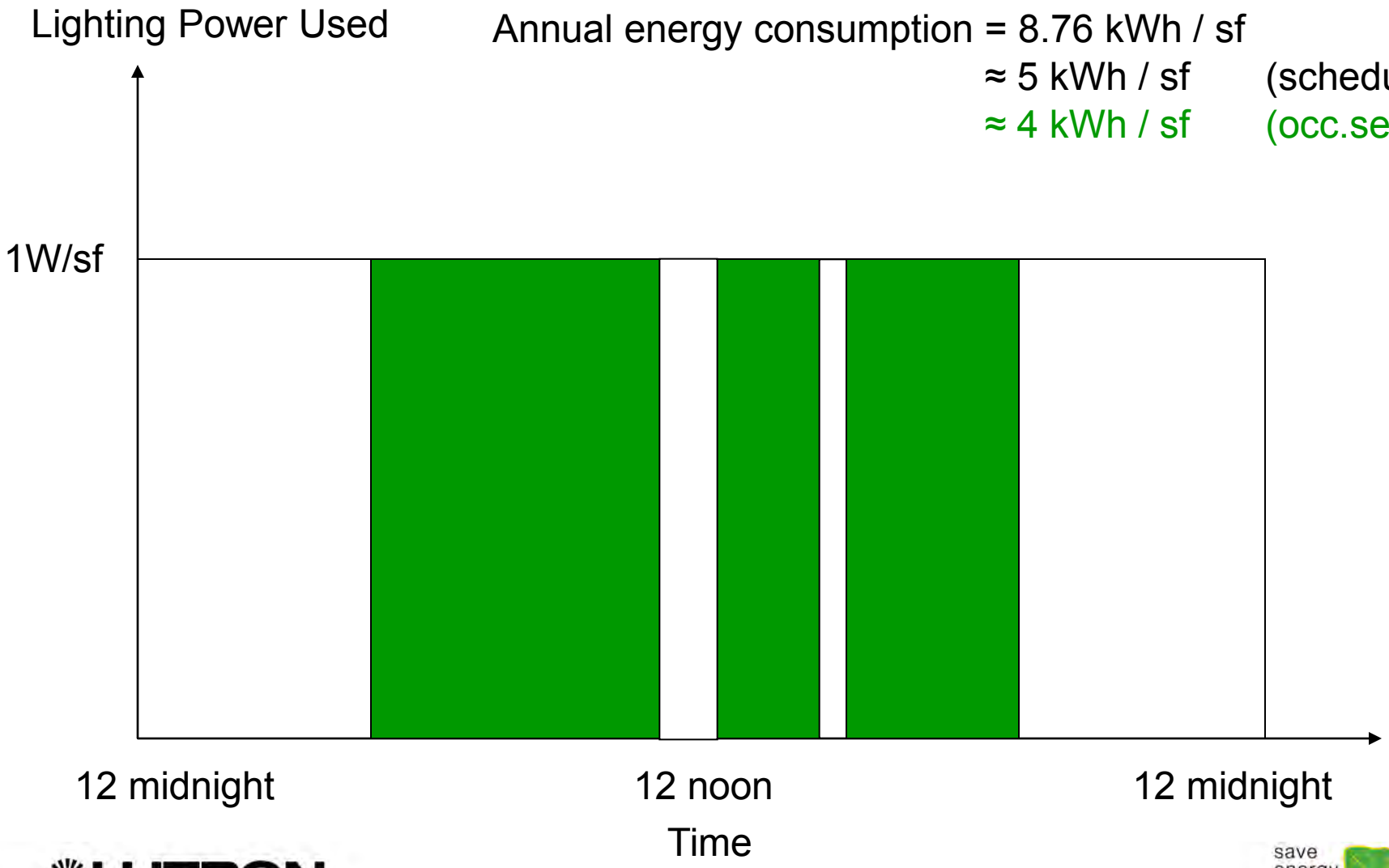
Office Building Example – Lighting Energy



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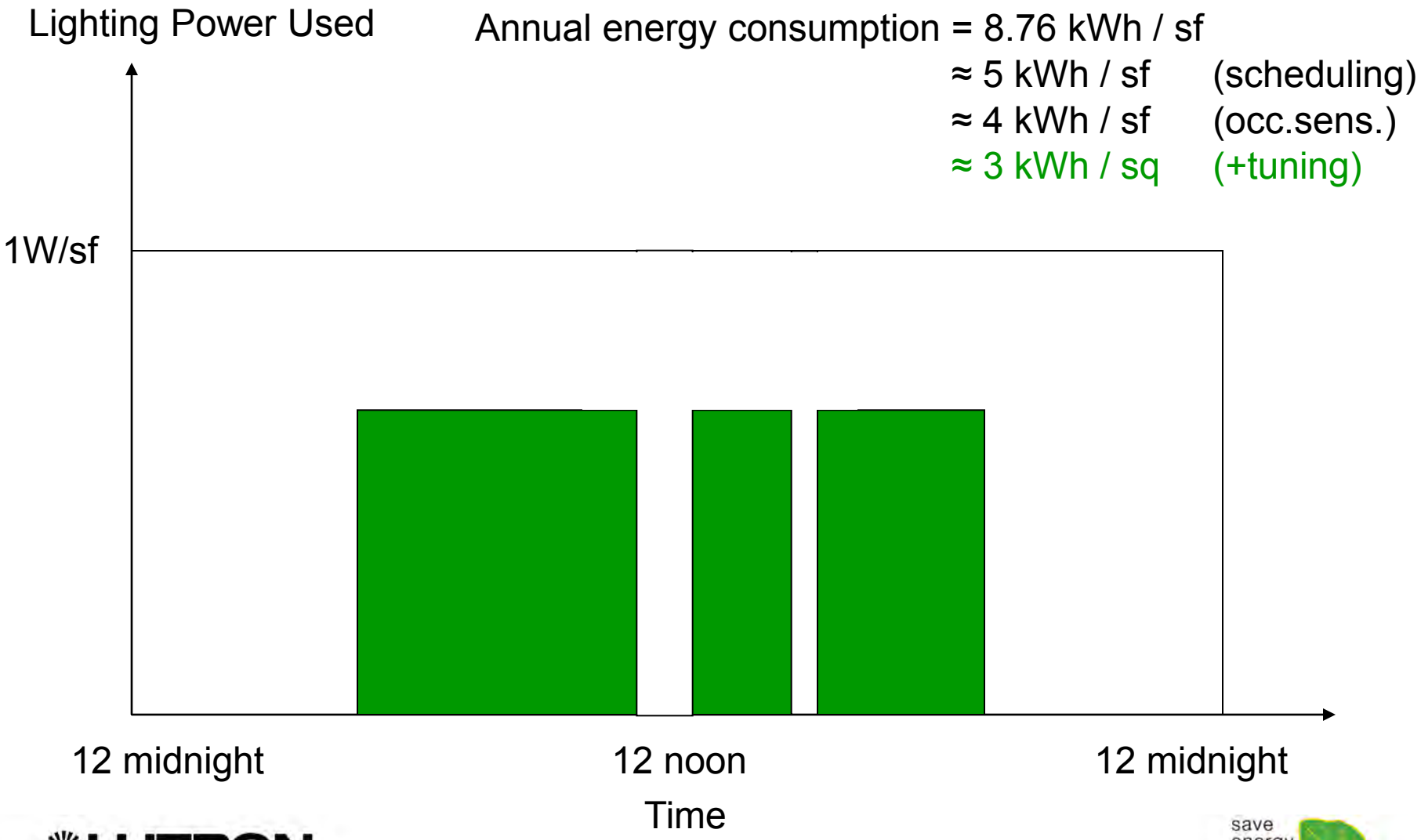
Office Building Example – Lighting Energy



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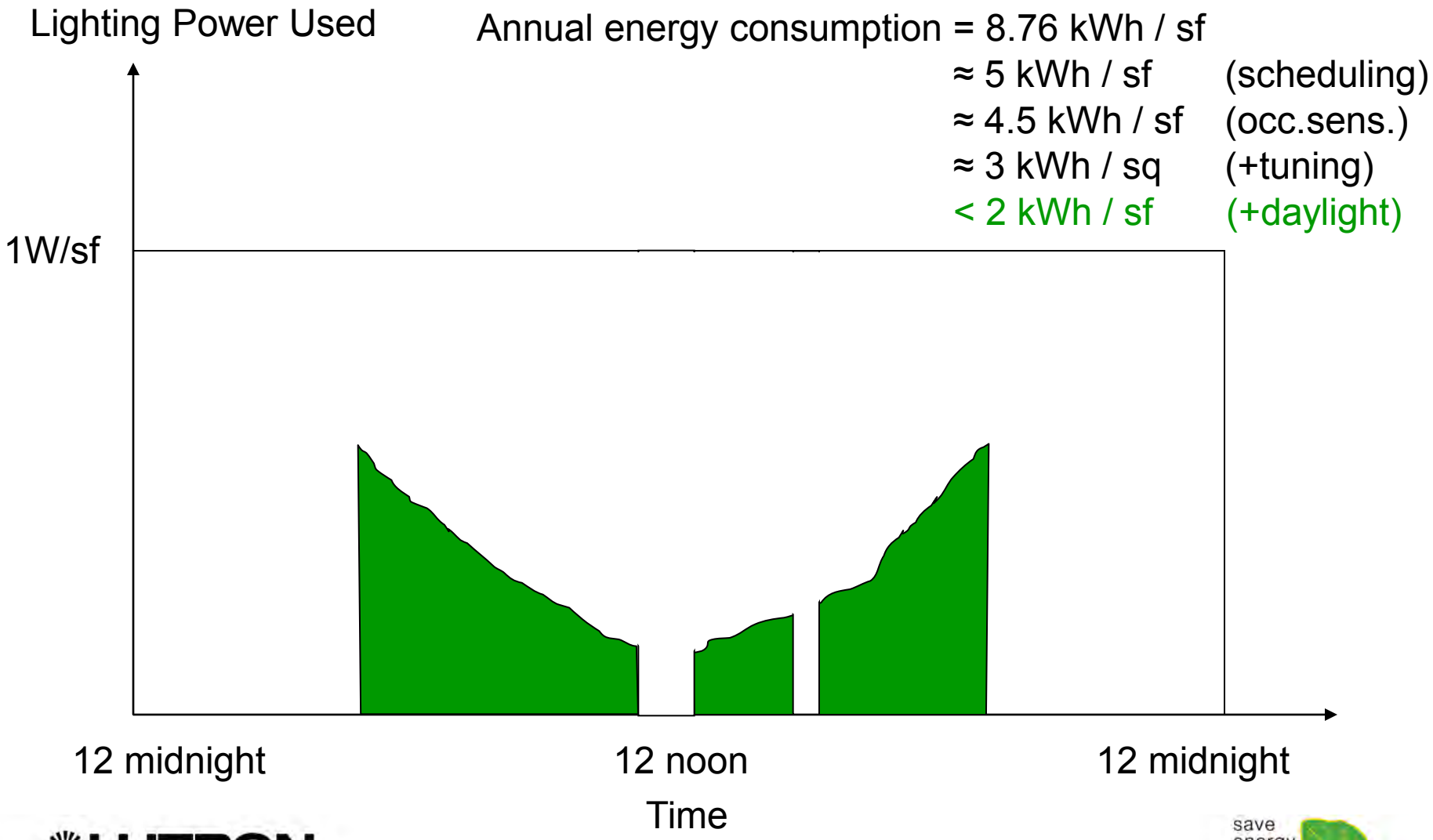
Office Building Example – Lighting Energy



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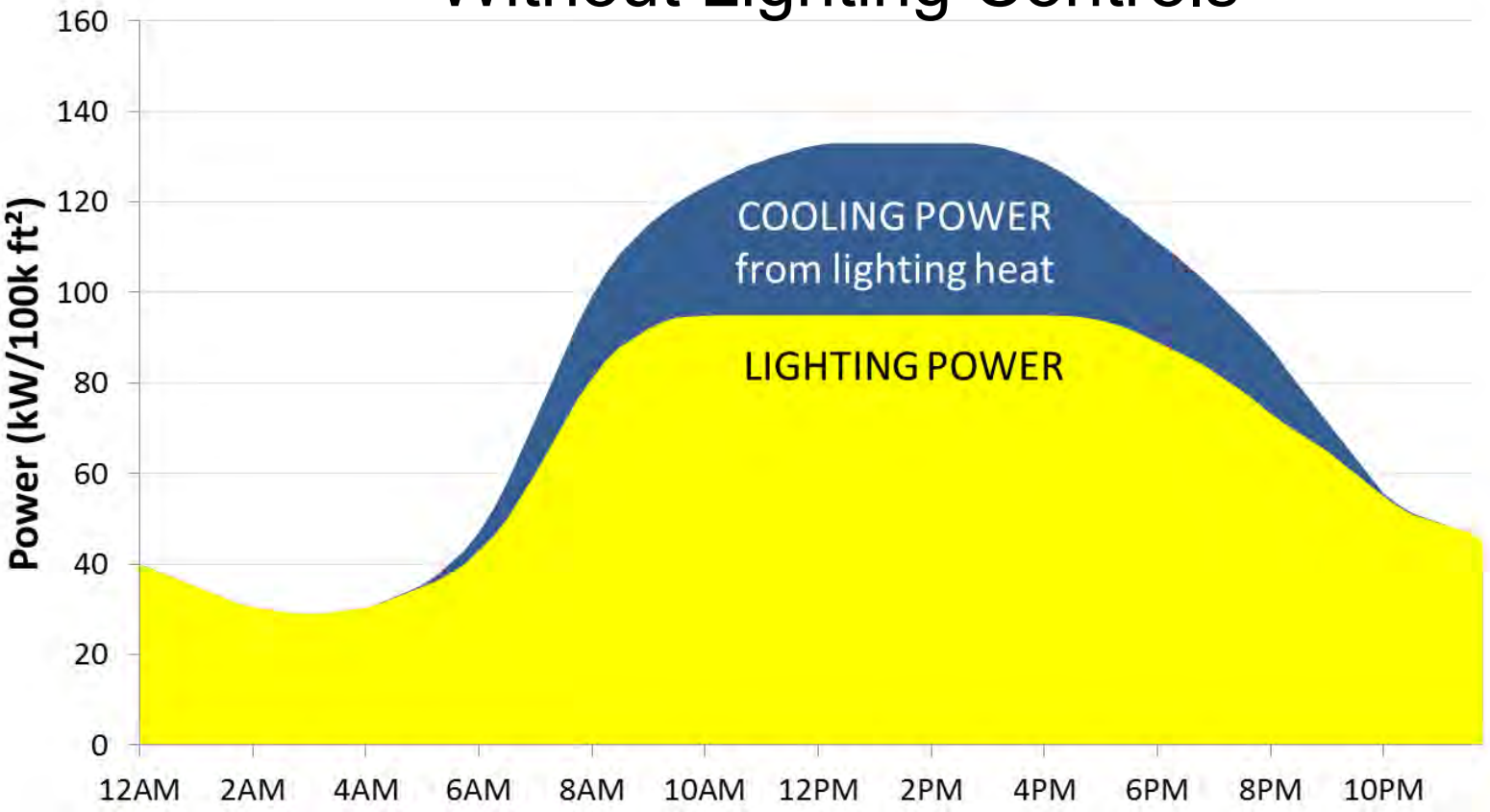
Peak Savings versus Energy Savings

Without Lighting Controls*



*Lighting power base on typical lighting load profile according to ASHRAE lighting schedules. Cooling power based on a minimum coefficient of performance of 3, which is not reached until mid-day.

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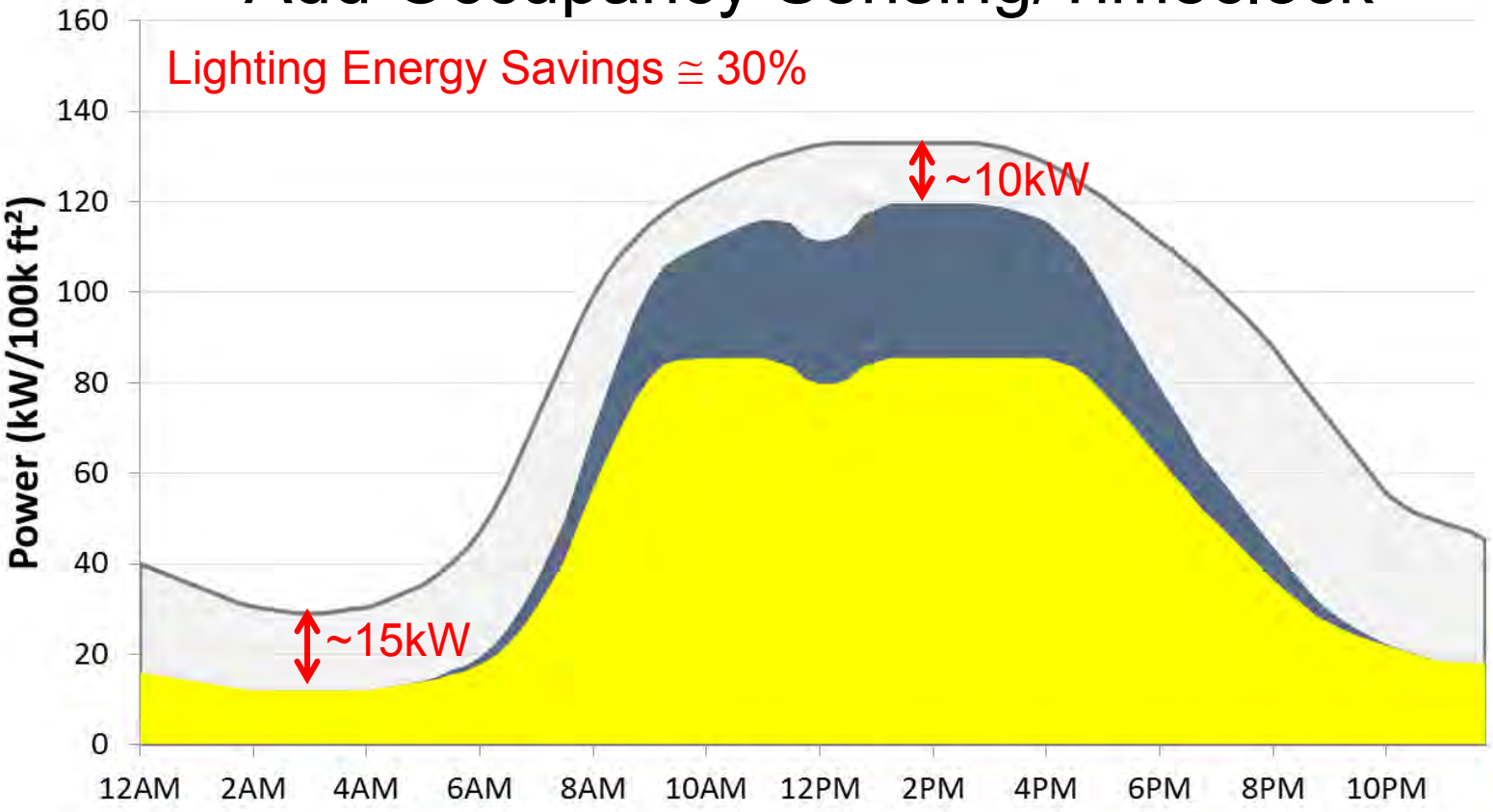
Peak Savings versus Energy Savings

Add Occupancy Sensing/Timeclock*



*Lighting power profile derived from 10 typical Lutron projects ranging in location from New York City, Portland, Boston, and Philadelphia. Cooling power based on a minimum coefficient of performance of 3, which is not reached until mid-day.

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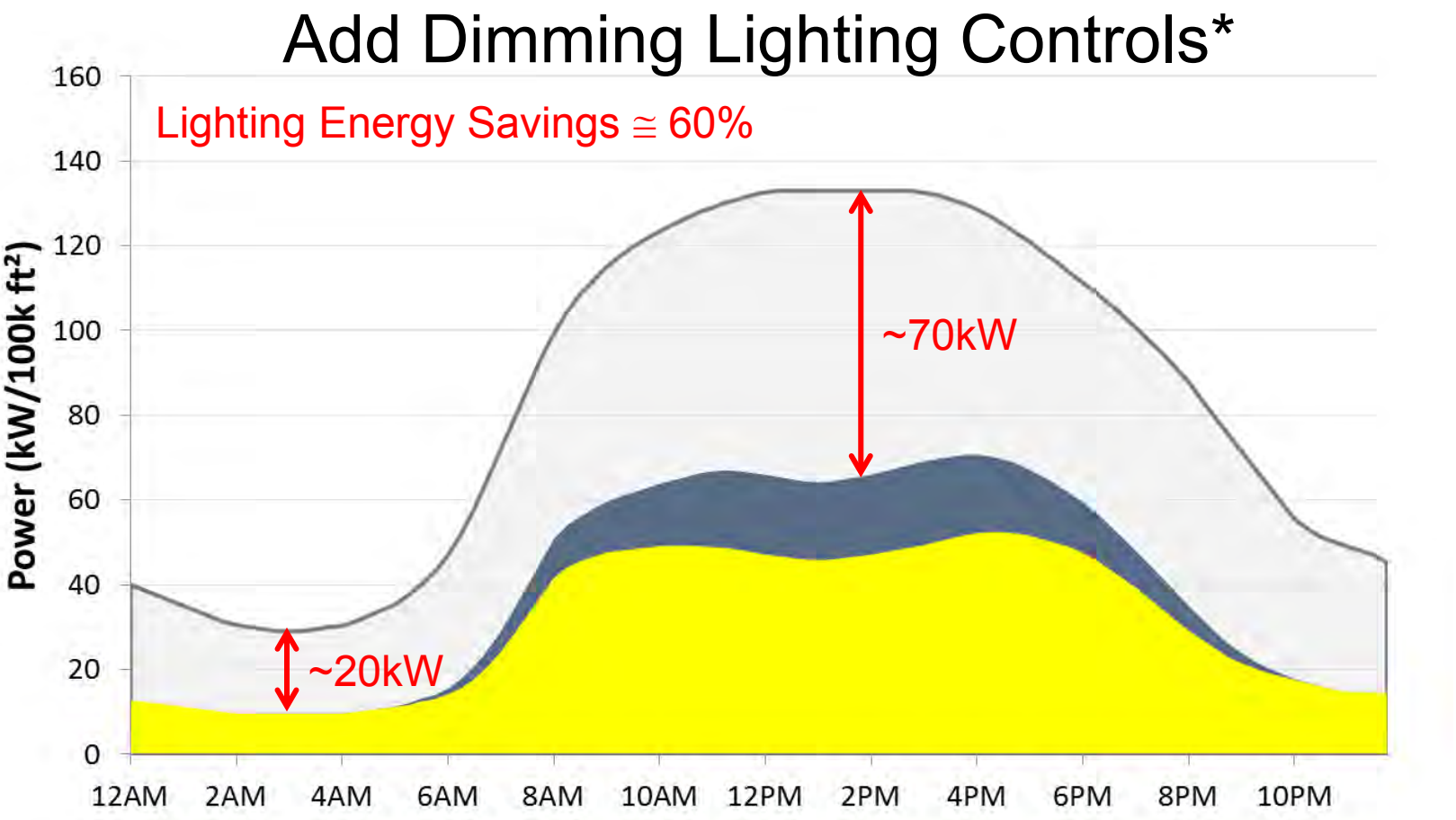
Peak Savings versus Energy Savings



*Lighting power profile derived from 10 typical Lutron projects ranging in location from New York City, Portland, Boston, and Philadelphia. Cooling power based on a minimum coefficient of performance of 3, which is not reached until mid-day.

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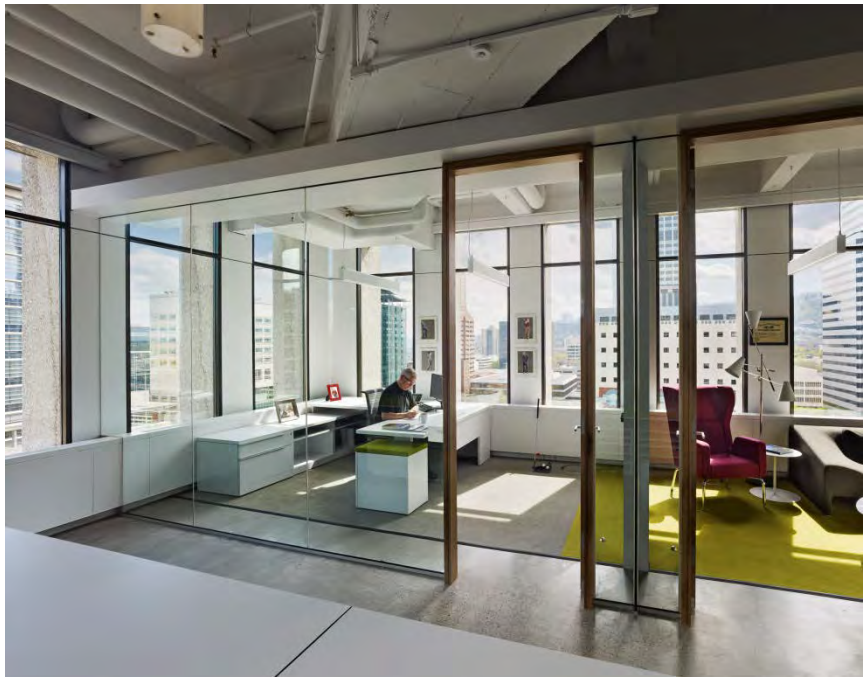
Case Studies of Lutron Installations: Glumac

Goal: Standard for energy efficiency in building renovations

Opened: 2012

Project Information:

- Reduce energy use by 47% compared to Oregon code
- Verify savings and further optimize lighting systems
- Maximize Occupant Comfort
- Wireless occupancy sensing, tuning, daylight harvesting, personal control



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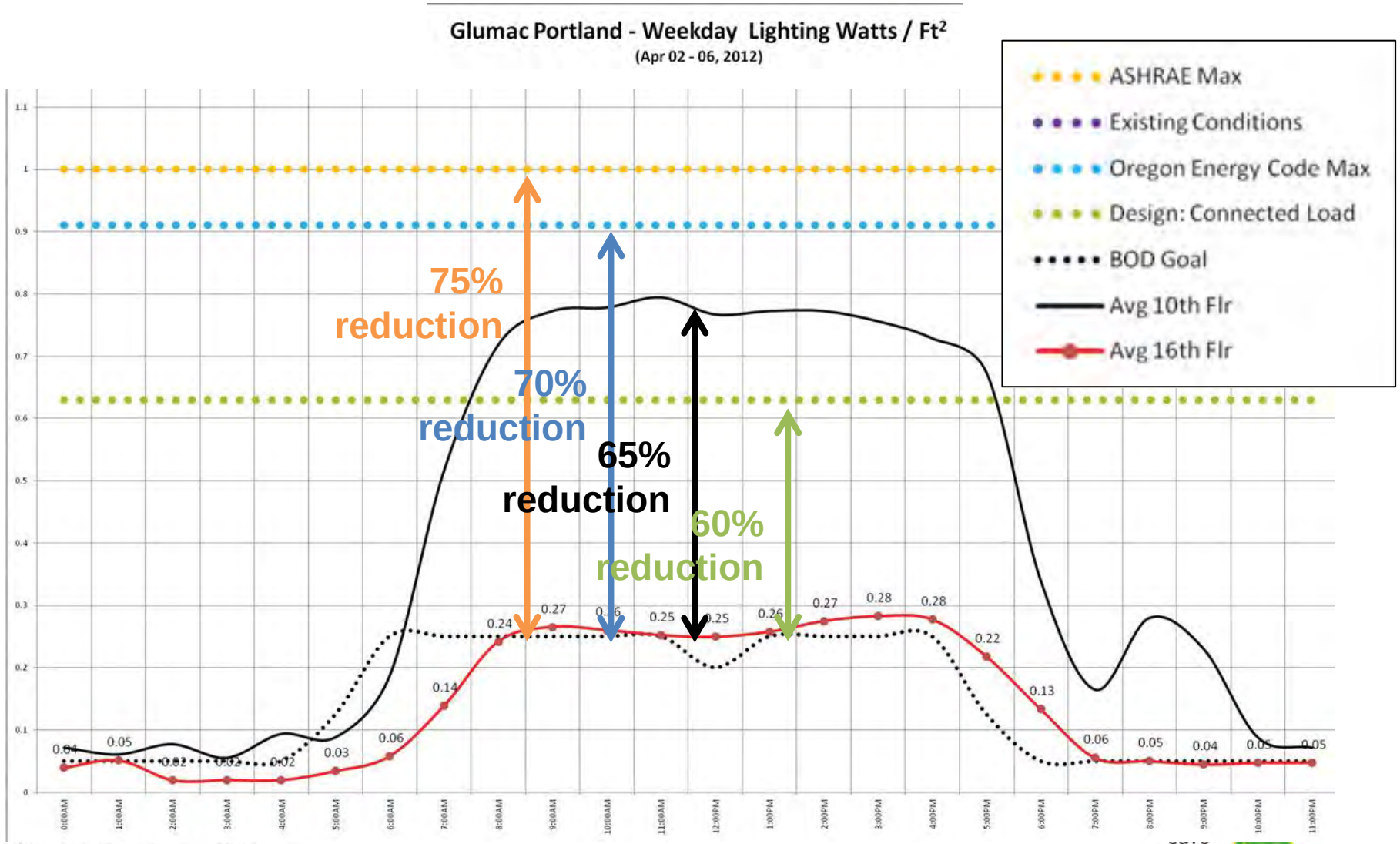
Case Studies of Lutron Installations: Glumac



Single Space Solutions

Family of Load Controllers, Sensors and Controls

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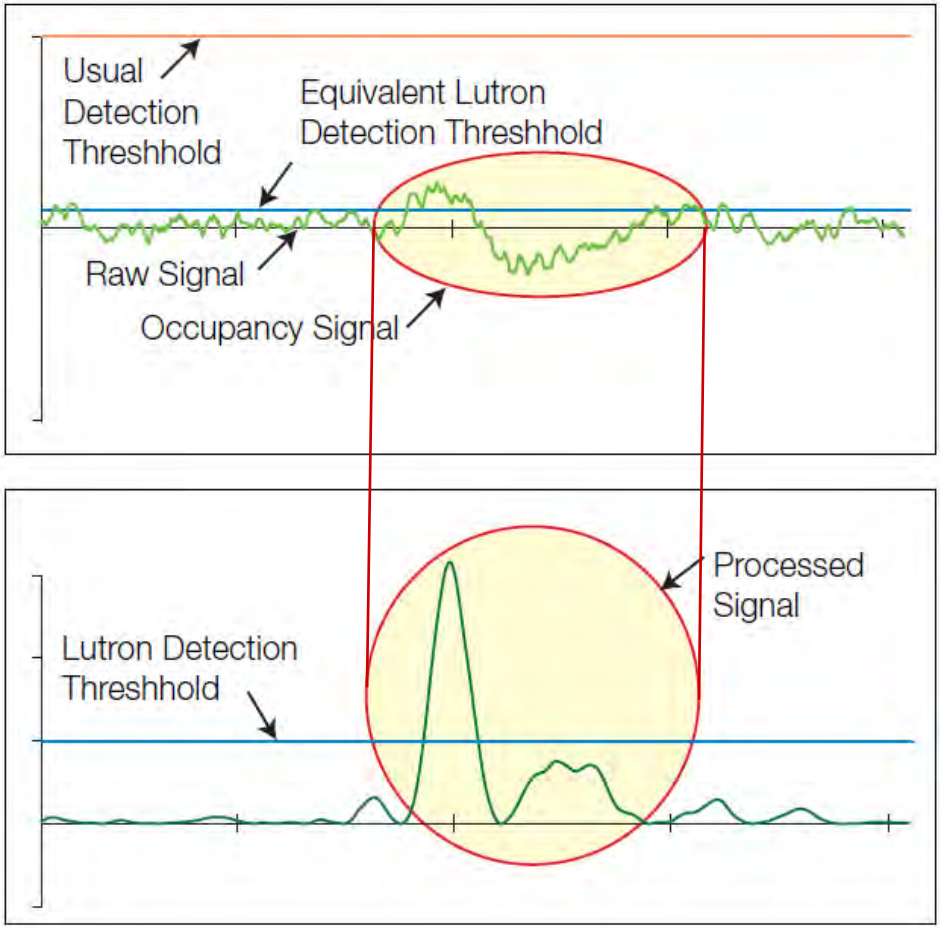
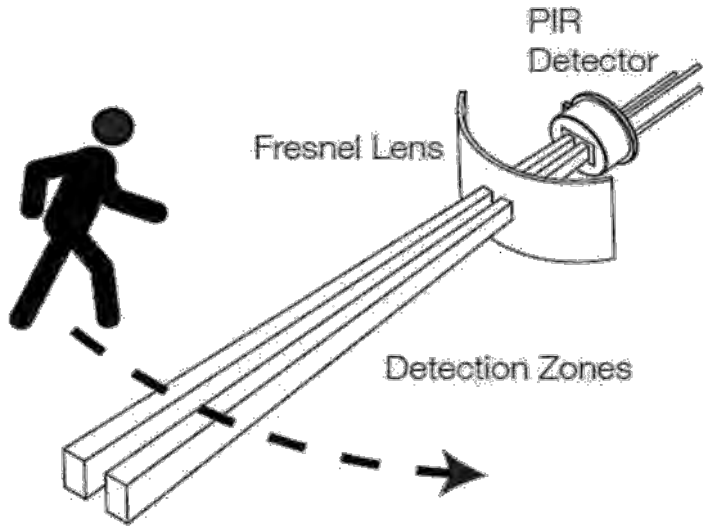
The Lutron Difference - XCT Technology

XCT™

- Signal processing algorithms distinguish between actual motions and noise without changing sensitivity
- Enables the sensor to detect small motion while significantly reducing false-tripping
- Applied in the ultrasound technology of dual tech sensors as well





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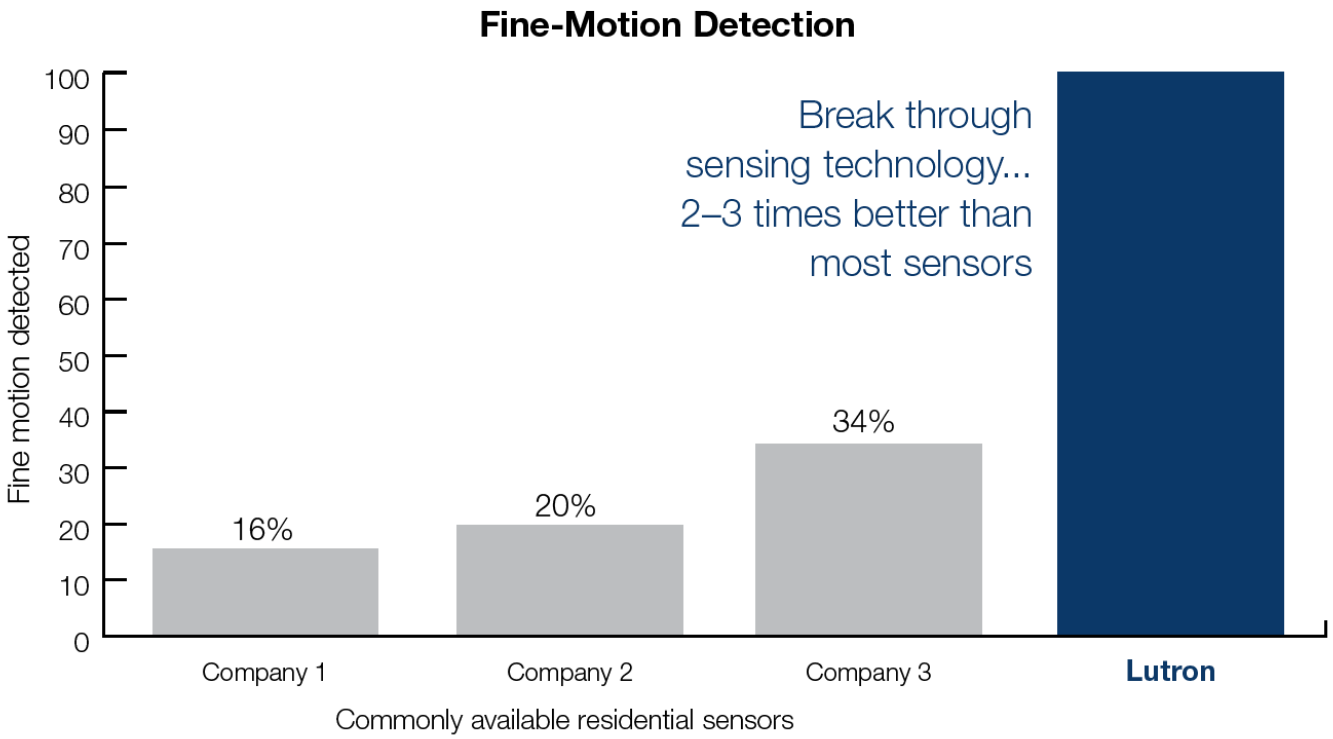
The Lutron Difference - XCT Comparison

XCT™ technology with auto-correlation – won't leave you in the dark

Lutron detects fine motion, like reading a book, better than other PIR sensors



We invented the fine-motion test! We wanted to stress our sensors beyond the NEMA major and minor motion tests.

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The Lutron Difference - Wireless

Reliable

Lutron wireless occupancy/vacancy sensors are also ultra-reliable. They communicate via our proprietary Clear Connect® RF technology. Clear Connect RF technology operates on a low frequency band (434 MHz) to avoid interference from other wireless devices, ensuring superb performance.

Clear Connect RF technology

In low uncongested frequency band – ultra-reliable operation

434 MHz:

- Lutron Clear Connect RF technology devices

Congested RF technology

In congested frequency bands – high potential for RF interference

2.4 GHz:

- Telephones
- Wi-Fi networks
- Bluetooth devices
- Wireless security cameras

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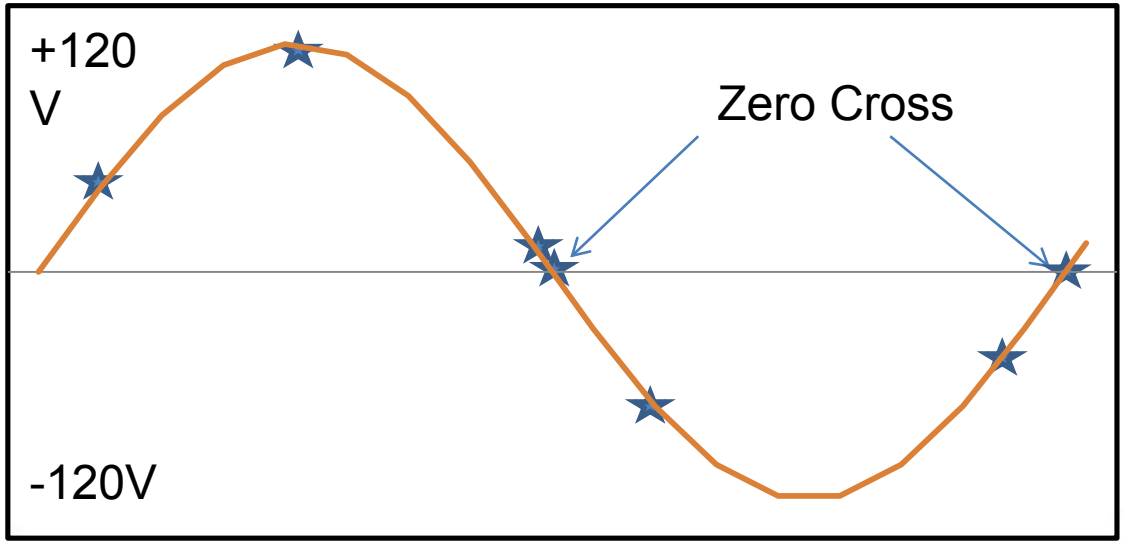
The Lutron Difference – Adaptive Relays

- High energy inrush of modern loads can destroy relays.
- Adaptively learns the optimum time to switch the relay depending on the lighting type – reducing arcing, extending the relay life.
- Relay life can be extended up to ten years.
- Lutron patent pending technology.



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Energi TriPak

Transmitting devices ∿▸ **Load controllers**

Sense

Radio Powr Savr™ wireless sensors

Occupancy/vacancy

Daylight

Adjust

Pico® wireless control

Wall-mount

Tabletop

Hand-held

Conserve

NEW PowPak™ load controllers

Dimming module with EcoSystem®

Relay module

Contact closure output module

Plug-in dimming module

Plug-in appliance module

Stairwell fixture

Maestro Wireless®

Dimmer

Switch

Tabletop lamp dimmer

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Energi TriPak – “Sense”

Transmitting Device

The “Sense” aspect of the Energi TriPak is made up of the Radio Powr Savr™ family of sensors:

- Wireless Occupancy Sensors
  - Ceiling-Mount
  - Wall-Mount
  - Corner-Mount
  - Hallway-Mount
- Daylight Sensors
  - Ceiling-Mount

These devices contain a battery with an estimated 10 year life and are designed to be quickly and easily placed, without the need to pull conduit or cable.

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Lutron Ceiling/Wall Occ Sensors

Wireless ceiling-mount | Wired ceiling-mount | Wireless wall-mount | Wired wall-mount | Wireless daylight

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Lutron Occupancy Sensor Models

Ceiling Mount Dual Technology Ceiling Mount

- LOS-CDT series
  - Ranges: 500, 1000, 2000 sq. ft.
  - Technologies: Self-Adaptive, dual technology
  - Special Features: Additional output model available (dry contact closure)

- LOS-CIR series
  - Ranges: 450, 1500 sq ft
  - Technologies: Self-Adaptive, Infrared

Energi TriPak – “Adjust”

Transmitting Device

The “Adjust” portion of the Energi TriPak is made up of the PICO™ family of remote controls:

- Wireless Remote Controls
  - Hand-Held
  - Wall-Mount
  - Pedestal-Mount
- Keypad Configurations such as:
  - 2-Button w/ and w/o Raise/Lower
  - 3-Button w/ and w/o Raise/Lower

These devices contain a battery with an estimated 10 year life and are designed to be quickly and easily placed, without the need to pull conduit or cable.

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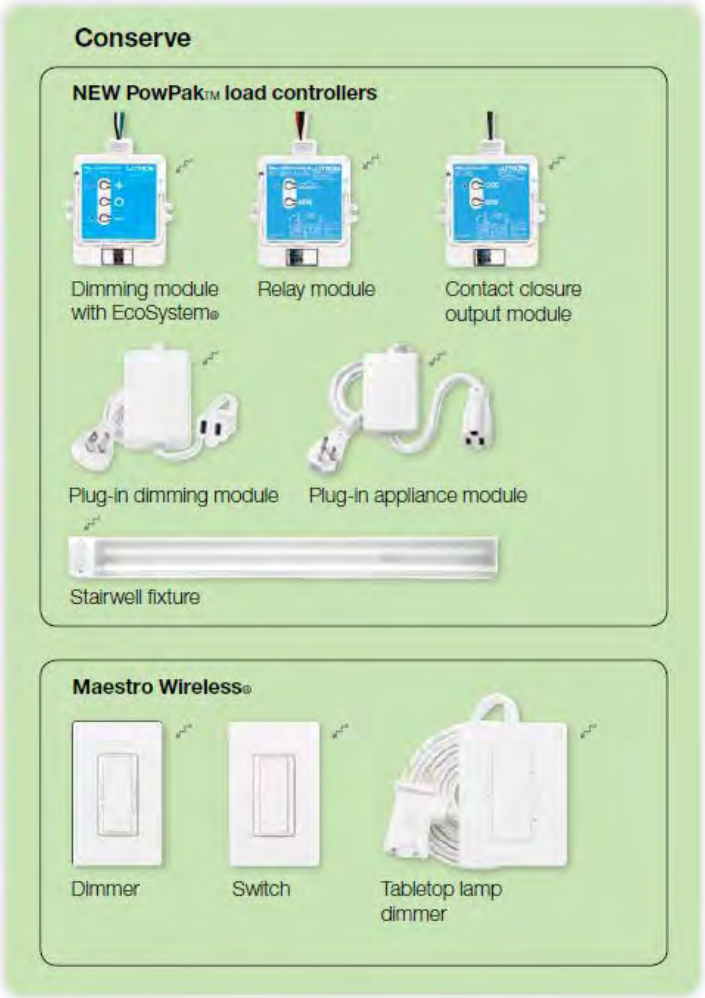
Energi TriPak – “Control”

Receiving Devices



The “Conserve” products of the Energi TriPak consist of load controllers and they come in various form factors:

- PowPak
  - Dimming PowPak w/ EcoSystem™
  - Dimming PowPak w/ 0-10V Control
  - SoftSwitch PowPak
  - SoftSwitch PowPak w/ Contact Closure Output

•Stairwell Fixture and Stairwell Fixture Kits

•Maestro Wireless Wall Switches and Dimmers

The Conserve products are all wireless receivers and draw power from a wired connection

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Maestro Sensor Family

120/277V 6A Switch
120V 2A Switch
120V 5A Switch

NEW!
6A / Circuit
120-277V

NEW
Dual Tech
6A Switch
120-277V

NEW
Dual Tech
6A / Circuit
120-277V

C.L Dimmer

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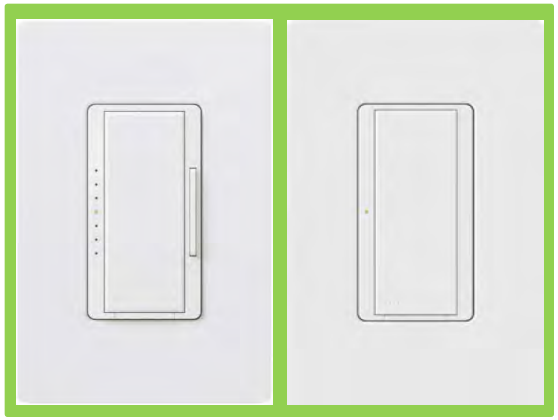
Maestro Wireless - Control

- Simple retrofit of existing wallbox switches and/or dimmers
- 120V/227V, no neutral required versions
- Compatible with multiple location companion switches for simple 3-way
- INC/HAL/MLV/ELV/3F/SW
- Advanced Programming Mode



Dimmer Switch

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PowPak Modules - Control

Junction-box Mount Modules – Wireless Power Packs

- PowPak Relay Module
- PowPak Digital Dimming Module (EcoSystem)
- PowPak Analog Dimming Module (0-10V)
- PowPak CCO Module

PowPak Relay Module
with SoftSwitch

PowPak Dimming
Module with EcoSystem

PowPak CCO Module

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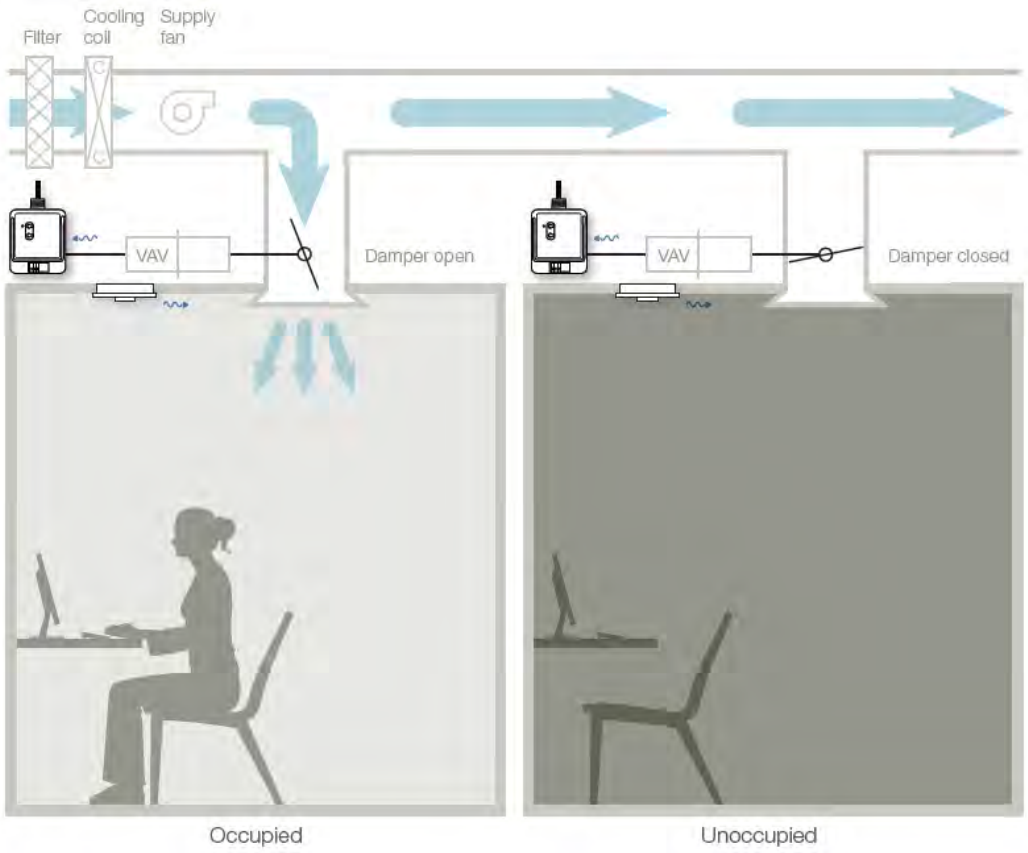
Application: HVAC Integration



- Occ sensor indicates room occupancy to VAV terminal unit to connect/disconnect room from HVAC system
- CCO on the PowPak relay can also be used in this way

NEW! PowPak 20A Relay Module

What is it?

- The PowPak 20 A Relay Module is a radio-frequency (RF), receptacle switching solution that is capable of controlling 20 A receptacles based on input from Pico® controls and Radio Powr Savr™ occupancy sensors.
- Communication with RF input devices, such as Pico controls and Radio Powr Savr™ sensors, is accomplished using Lutron® Clear Connect® RF Technology.

Key Info:

- Can Spec NOW
- Shipping April 1
- $300 LIST
- RMJ-H20R-DV-B

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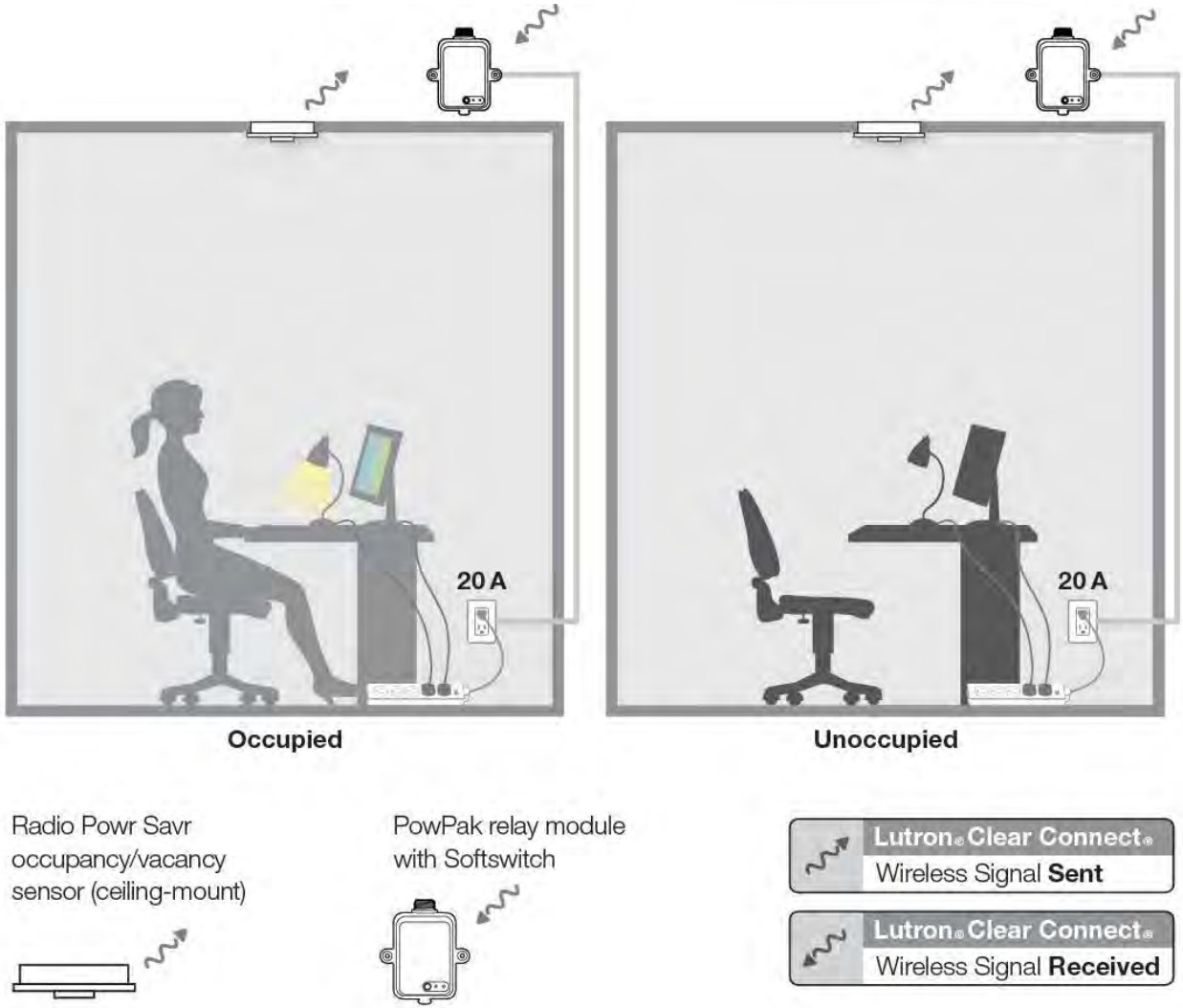
NEW! PowPak 20A Relay Module

Application



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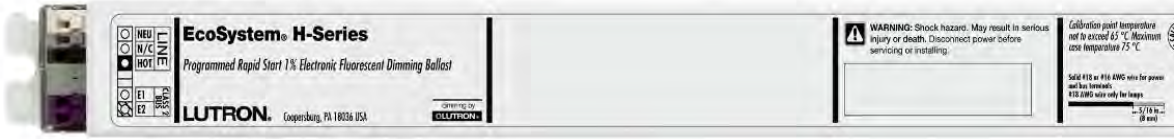
Fluorescent Ballasts

- Ecosystem H-Series Ballast
  - Dims to 1%
  - Ecosystem only control
  - Most cost-effective ballast solution
  - Available in T8, T5, T5HO, Reduced Wattage T8

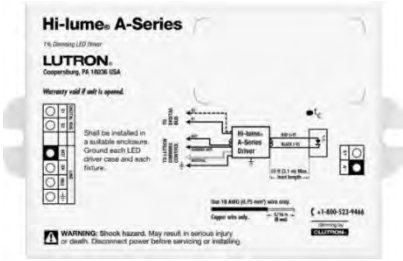


- Hi-Lume 3D Ballast
  - Dims to 1%
  - 3-wire & Ecosystem dimming control
  - Available in T8, T5, T5HO, Reduced Wattage T8

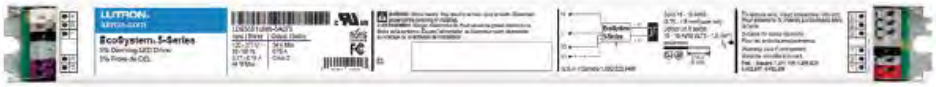
- Ecosystem Compact Fluorescent Ballasts

LED Drivers

- Lutron A-Series Driver:
  - Highest level of compatibility with LED arrays
  - Ecosystem, 3-wire, and 2-wire dimming options
  - 1% Dimming



- Lutron 5-Series:
  - Constant current, Ecosystem control only
  - 5% dimming
  - Lowest cost driver
  - Higher wattage for linear and 2x4 applications



- Lutron A-Series UL Listed Driver:
  - 1% dimming, 12 or 24v constant voltage
  - UL Listed via j-box mounting, allowing to field install
  - Typical application includes LED cove, strip lighting

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Embedded Ecosystem Partners

- Enables digital intelligence and seamless control of third-party fixtures
- Guarantees compatibility between fixtures and controls system performance assured by Lutron global support and service
- Lower installed fixture cost (in most cases)
- ***Fixture manufactures using the chip today: Cree, Lumenpulse, and Lunera, GE, Luminetix***

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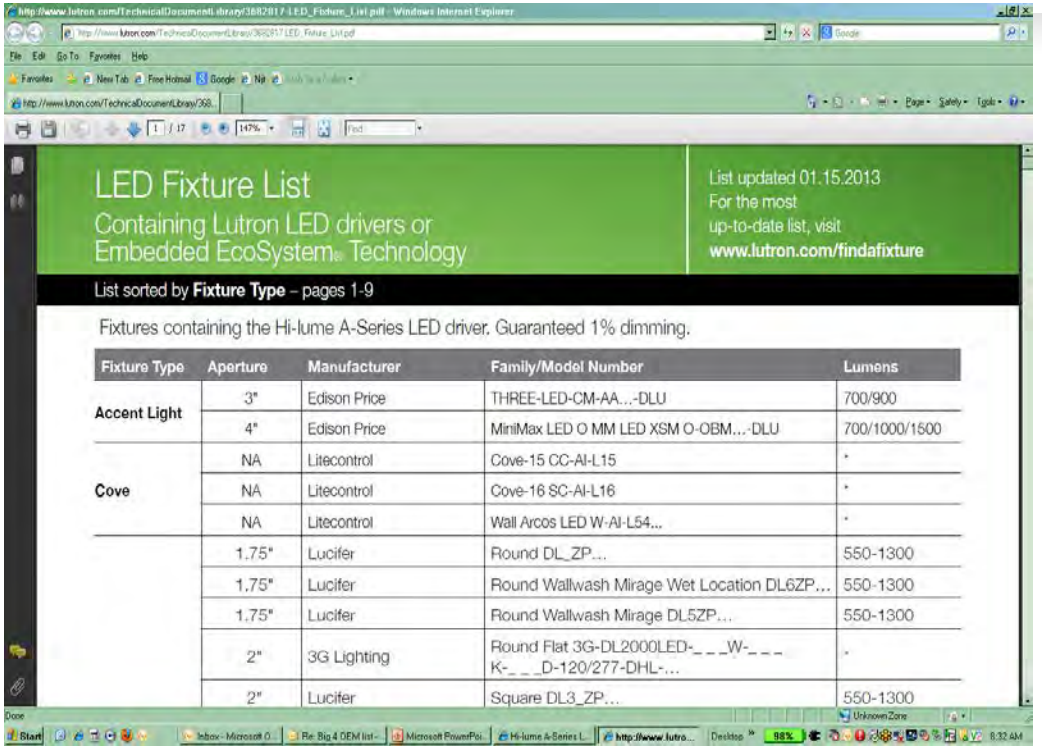
LED Driver Tools & Resources

High Performance LED Fixture List

Find:

- Fixtures with Lutron drivers UL Listed :
  - Listed by LED fixture type
  - Listed by LED fixture manufacturer



LED Fixture List

Containing Lutron LED drivers or Embedded EcoSystem® Technology

List updated 01.15.2013
For the most up-to-date list, visit
www.lutron.com/findafixture

List sorted by **Fixture Type** – pages 1-9

Fixtures containing the Hi-lume A-Series LED driver. Guaranteed 1% dimming.

Fixture Type	Aperture	Manufacturer	Family/Model Number	Lumens
Accent Light	3"	Edison Price	THREE-LED-CM-AA...-DLU	700/900
	4"	Edison Price	MiniMax LED O MM LED XSM O-OBM...-DLU	700/1000/1500
Cove	NA	Litecontrol	Cove-15 CC-AI-L15	*
	NA	Litecontrol	Cove-16 SC-AI-L16	*
	NA	Litecontrol	Wall Arcos LED W-AI-L54...	*
	1.75"	Lucifer	Round DL_ZP...	550-1300
	1.75"	Lucifer	Round Wallwash Mirage Wet Location DL6ZP...	550-1300
	1.75"	Lucifer	Round Wallwash Mirage DL5ZP...	550-1300
	2"	3G Lighting	Round Flat 3G-DL2000LED-_ _ _W-_ _ _ K-_ _ _D-120/277-DHL-...	*
	2"	Lucifer	Square DL3_ZP...	550-1300

www.lutron.com/findafixture

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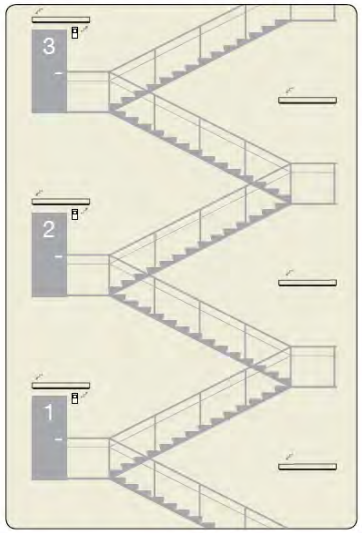
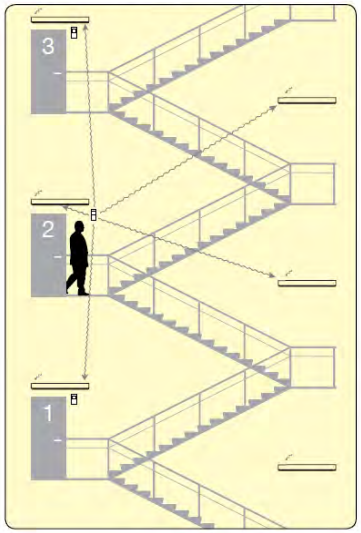
LED Stairwell

How does it work?

Unoccupied: 10% light level



Occupied: 50% light level



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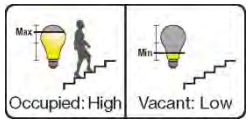
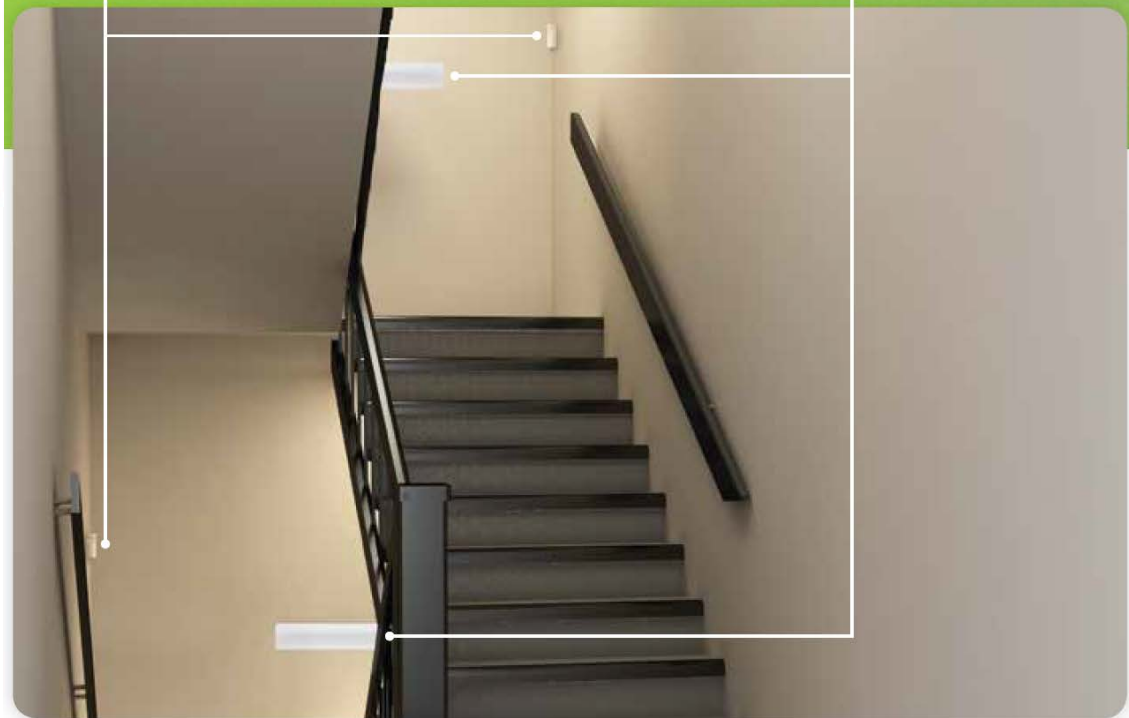


Stairwell Fixture Solutions

Stairwell Fluorescent and LED fixture

Radio Powr Savr™ wireless corner-mount occupancy sensor

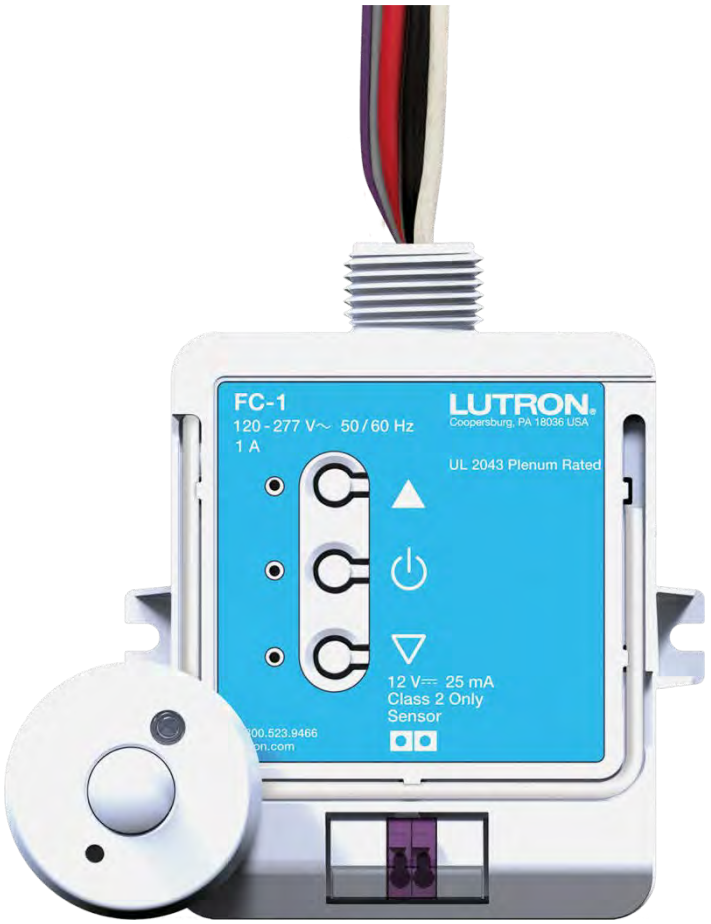


Lutron Wireless Fixture Controller - NEW

What is it?

- The Lutron Wireless Fixture Controller is an individual fixture control and a combined occupancy and daylight sensor designed to be added to each fixture in a space.

- The controller has Clear Connect RF communication for adding new points of control
  - Pico wireless remotes
  - Wireless Radio Powr Savr occupancy and daylight sensors



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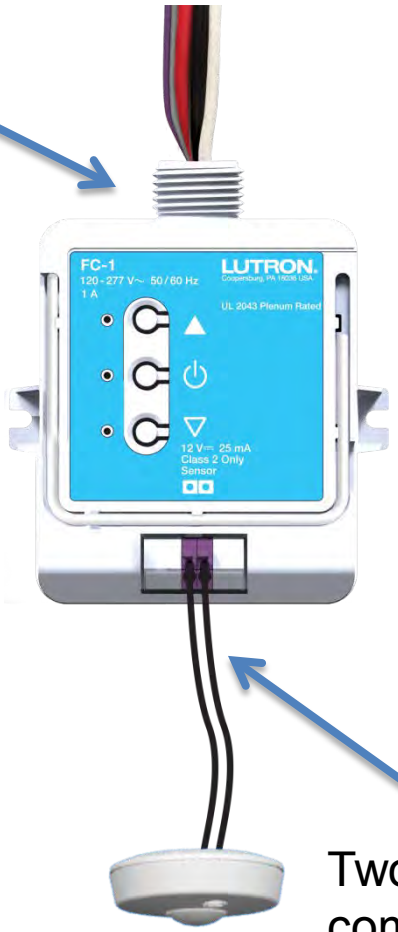
Lutron Wireless Fixture Controller

Mount to a standard US knockout



Two wire communication link

0-10V Control

Daylight Sensor

PIR Occupancy Sensor

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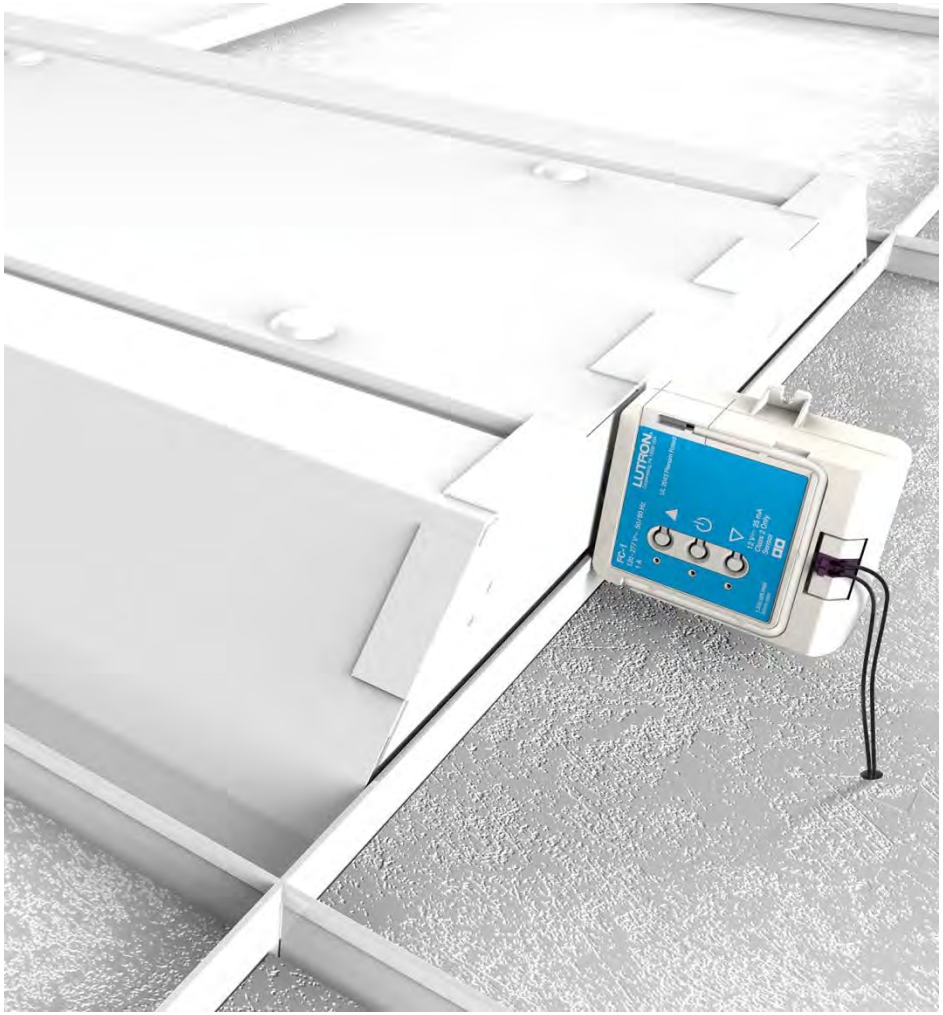
Lutron Wireless Fixture Controller

Below the Ceiling

Above the Ceiling



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Lutron Wireless Fixture Controller

Eliminate Design Hassle

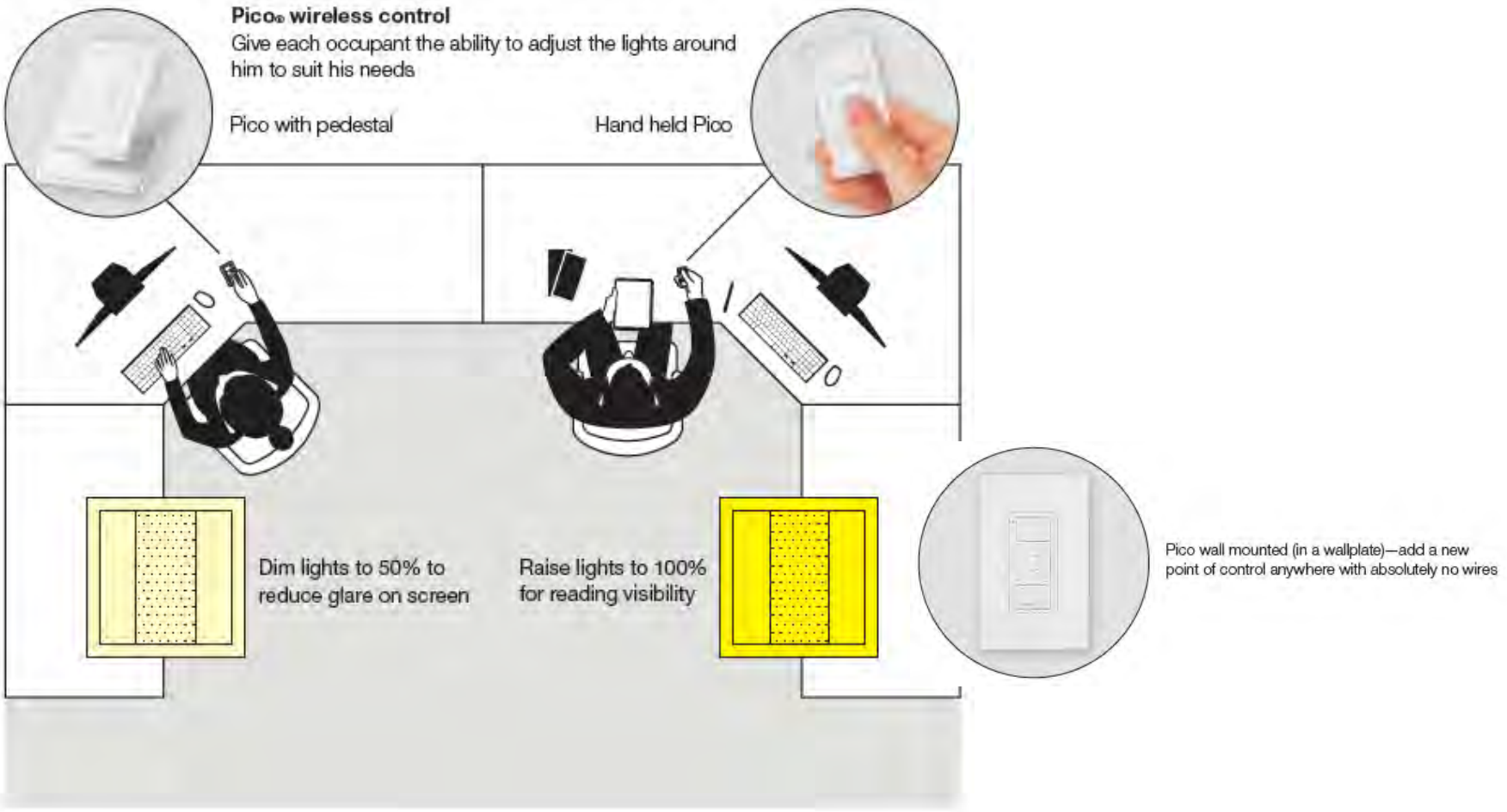
- Just count the number of fixtures
  - No need to know existing wiring
- Code Compliant out of the box
- Works with anyone's fixture
  - Automatically adapts to sink or source 0-10V

Simplify Installation

- Step and repeat installation process
  - No control wiring required
  - No programming required

Lutron Wireless Fixture Controller

Add Personal Control Anywhere



LUTRON®

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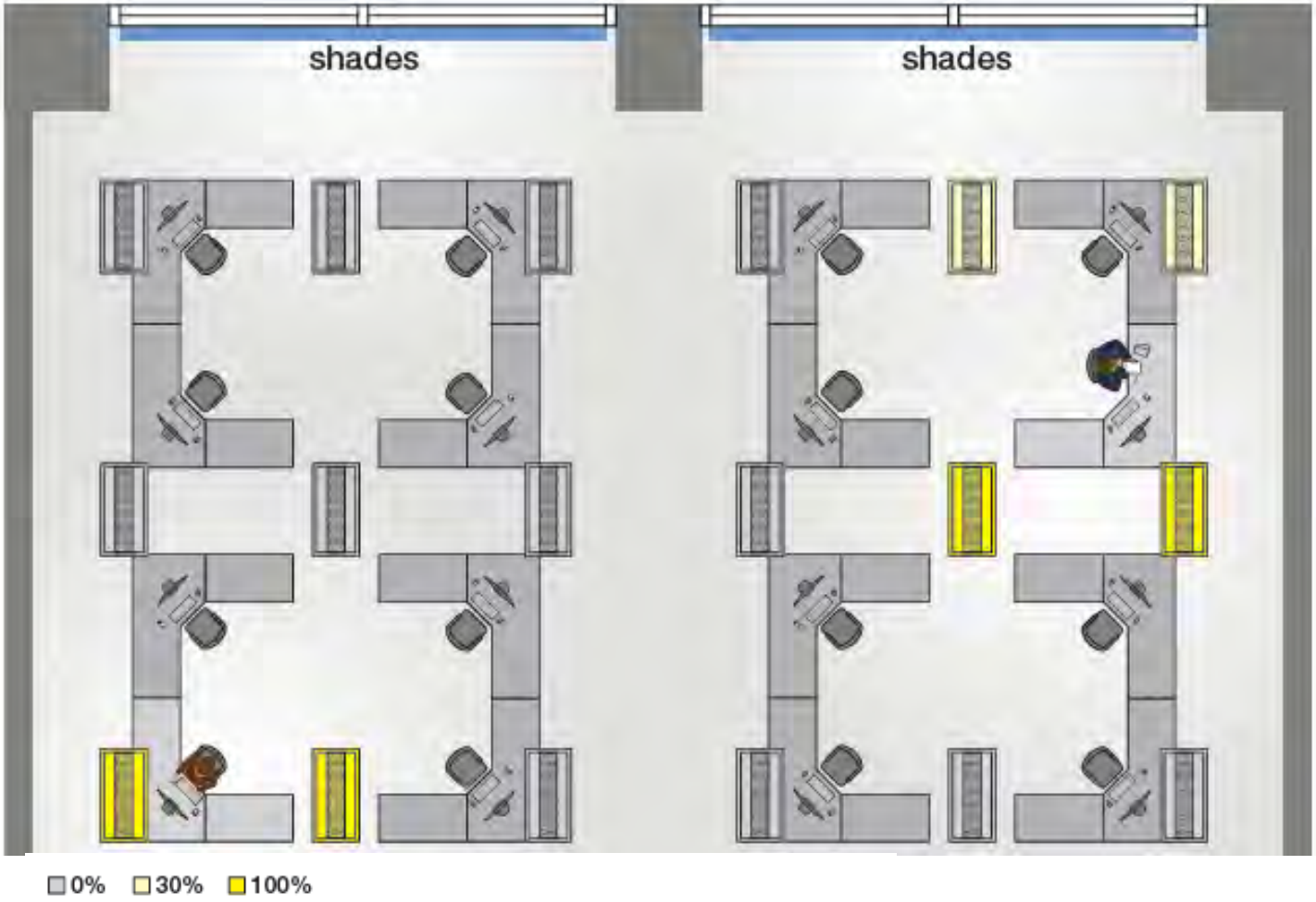
Lutron Wireless Fixture Controller

Maximize Energy Savings by providing only the light you need



LUTRON®

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Technical Details

1. 1 module per fixture (Switches 1 Amp Max)
2. Controls 0-10V drivers/ballasts (sink or source adaptive)
3. Plenum rated
4. XCT PIR Sensor
5. Green laser pointer association
6. Clear Connect RF Technology (30’ range) Compatible with Pico and Radio Powr Savr Sensors
7. Mounts to a standard knockout on the outside of the fixture

Lutron Wireless Fixture Controller

Occupancy sensing

Turns individual fixtures on when people occupy the area

Turns individual fixtures off when people vacate the area

Daylight harvesting

Dims/brightens the fixture to take advantage of daylight

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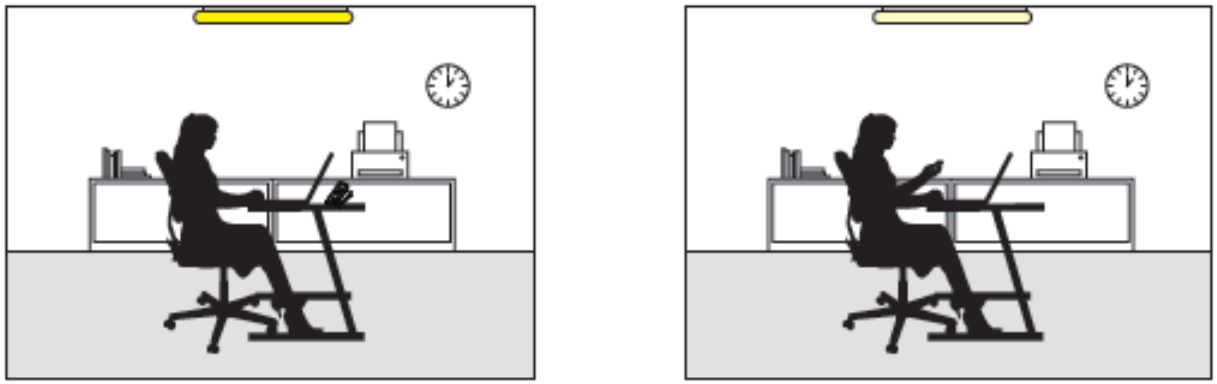
Lutron Wireless Fixture Controller (continued)

Personal wireless control



Adjusts light level based on wireless remote button presses

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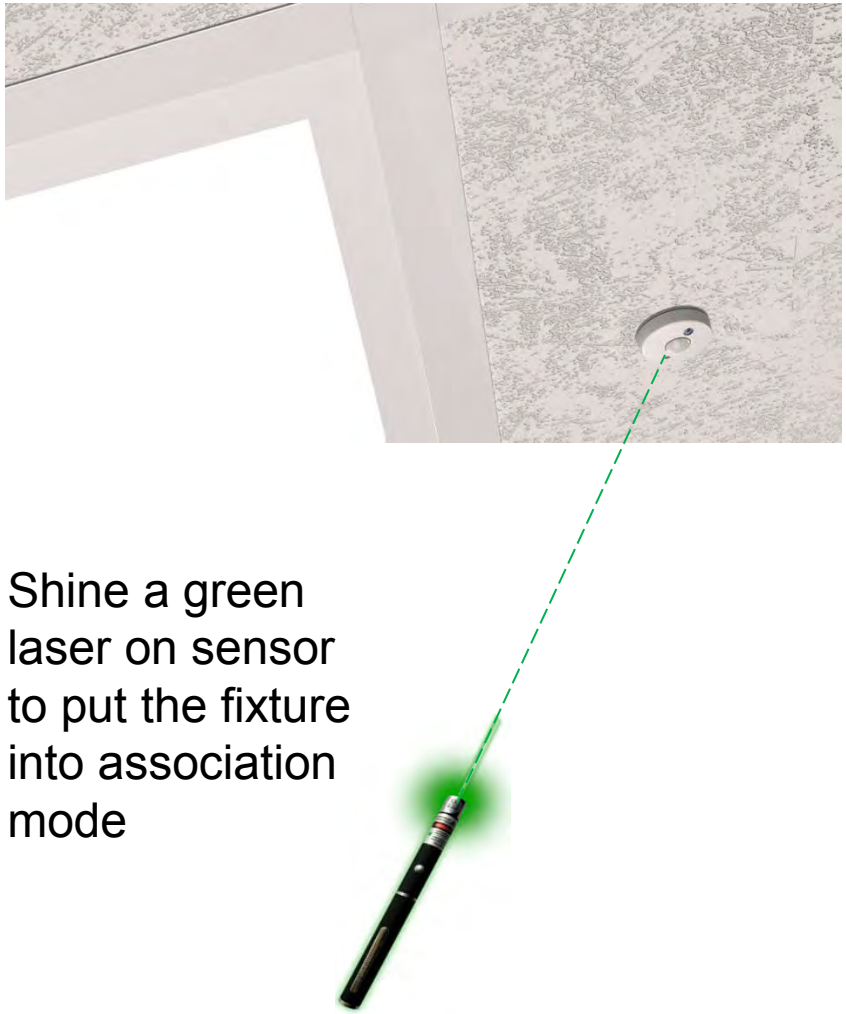
Green Laser Association



Shine a green laser on sensor to put the fixture into association mode

Then press and hold a button on the desired device to complete assignment

LUTRON

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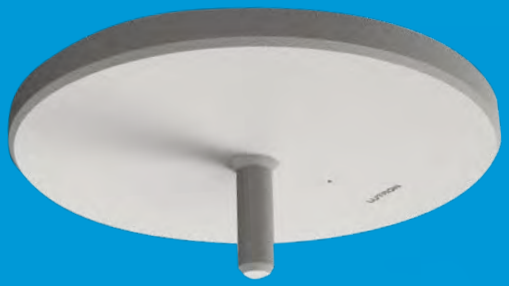
INTRODUCING

Energi TriPak® Hub

Taking easy to a whole new level

Energi TriPak® Hub

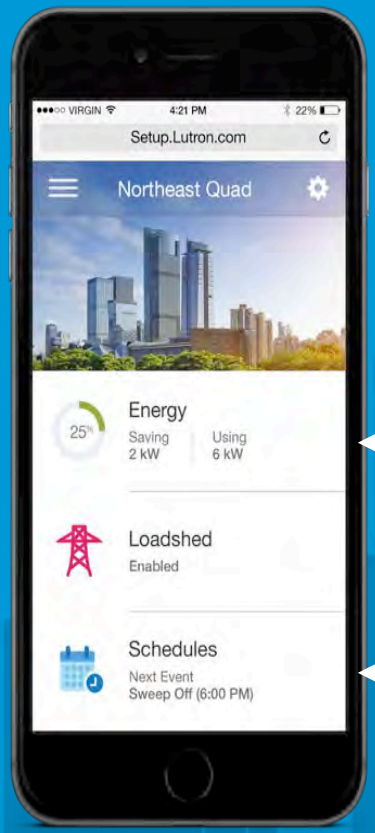
Big-system benefits for any building



Energi TriPak Hub

BACnet integration

Automatic demand response



Energy reporting

Central timeclock

Energi TriPak® Hub

A full family of wireless, retrofit products

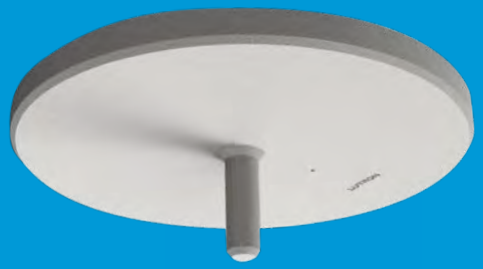
Wireless sensors

Pico® wireless remotes

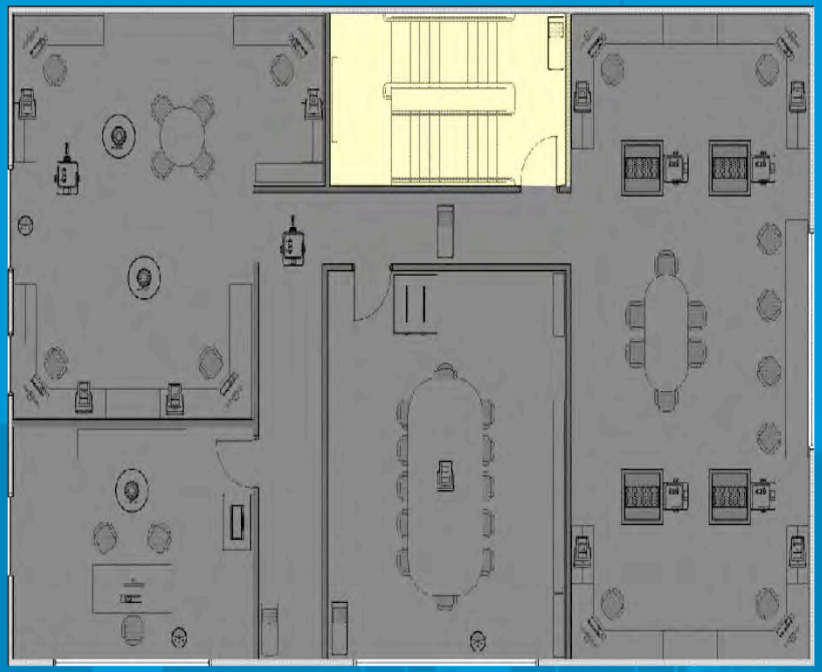
Wireless load controllers

Energi TriPak® Hub

Connects your wireless products



Energi TriPak Hub

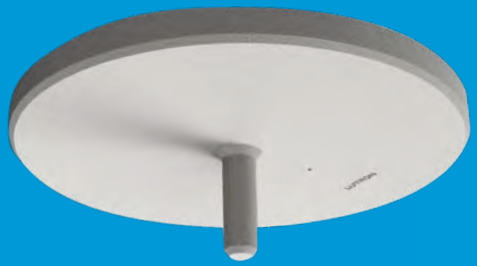


Full On Dimmed Full Off

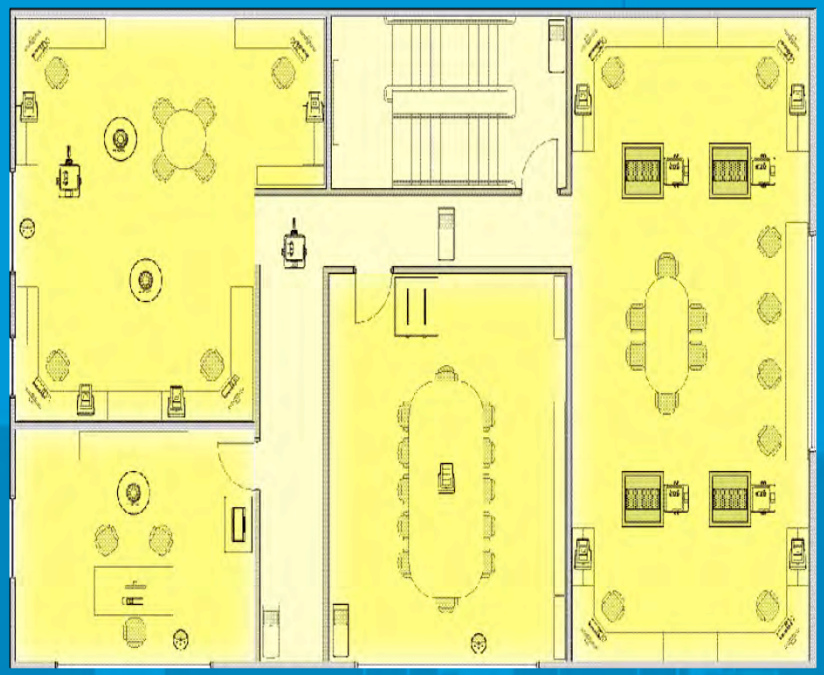
Energi TriPak® Hub

Connects your wireless products

Time Clock: Sweep on – 7 a.m.



Energi TriPak Hub



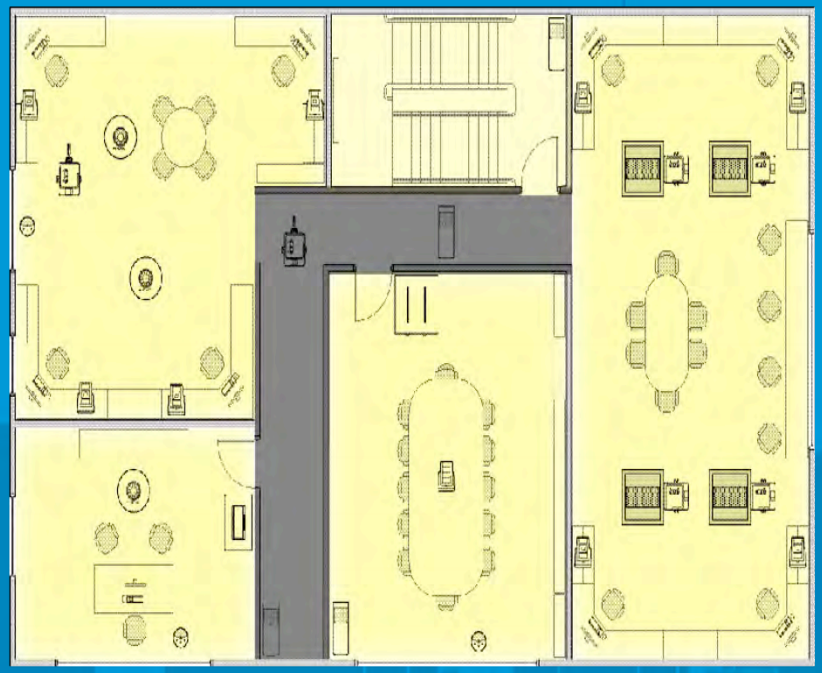
Full On Dimmed Full Off

Energi TriPak® Hub

Connects your wireless products

Energi TriPak Hub

Automatic demand response: Lights dim



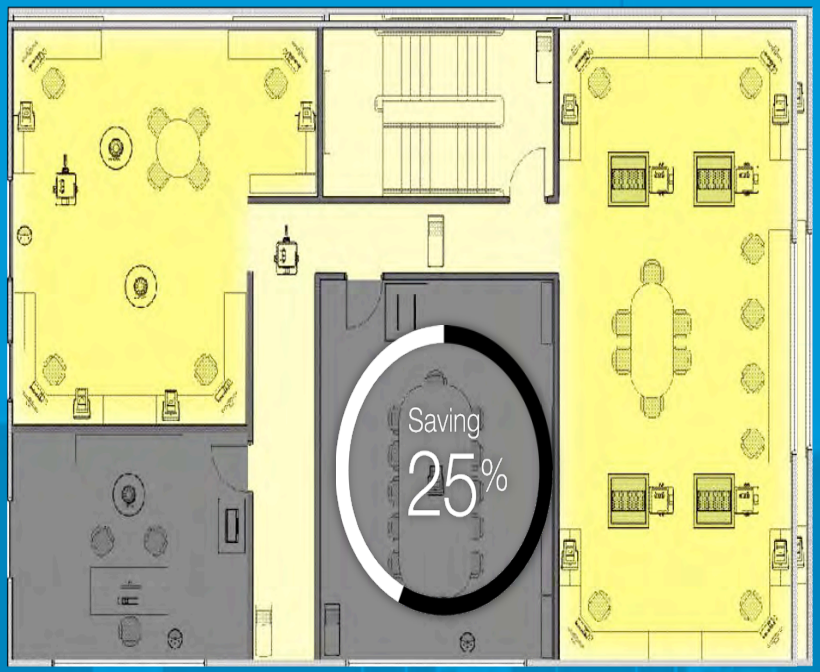
Full On Dimmed Full Off

Energi TriPak® Hub

Connects your wireless products

Energi TriPak Hub

Monitor energy savings



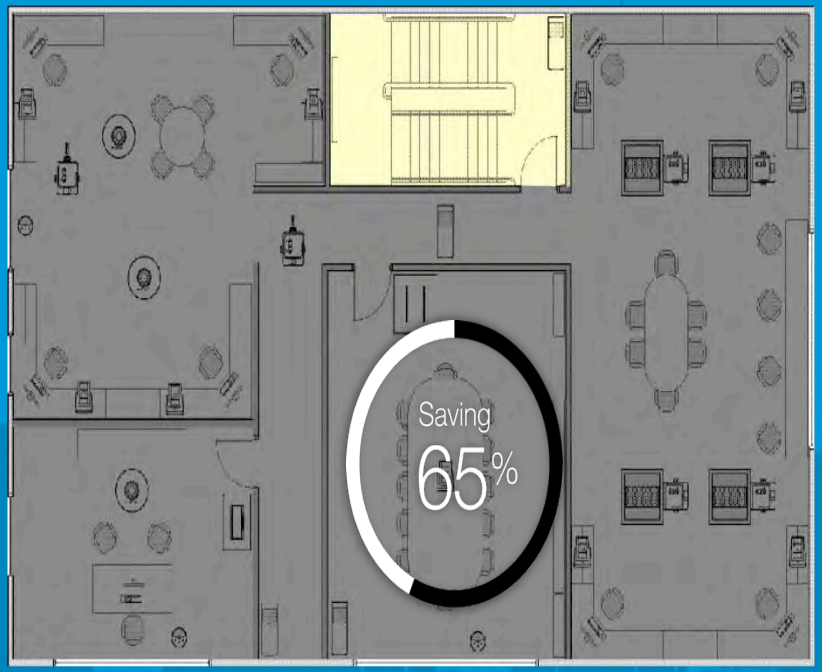
Full On Dimmed Full Off

Energi TriPak® Hub

Connects your wireless products

Time Clock: Sweep off – 8 p.m.

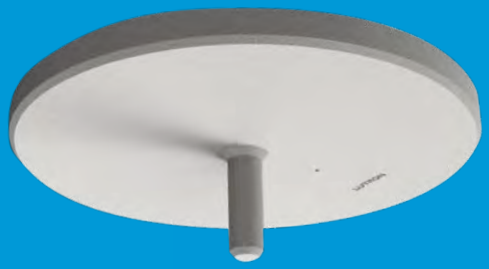
Energi TriPak Hub



Full On Dimmed Full Off

Energi TriPak® Hub

Seamlessly integrate with your building's systems



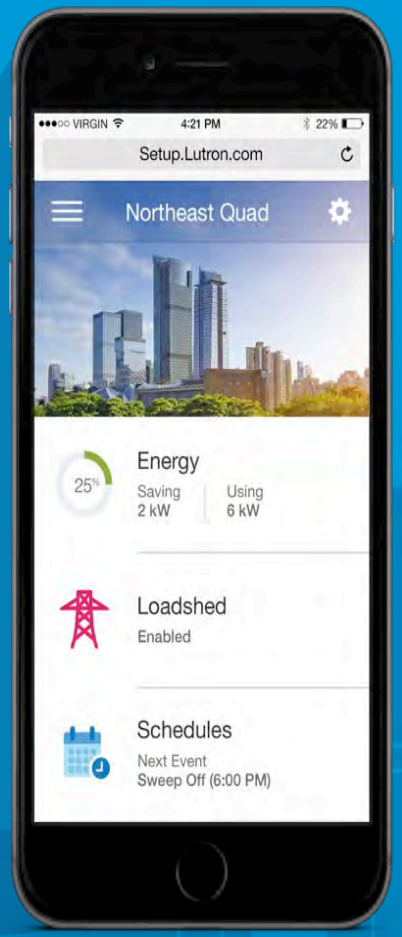
Energi TriPak Hub

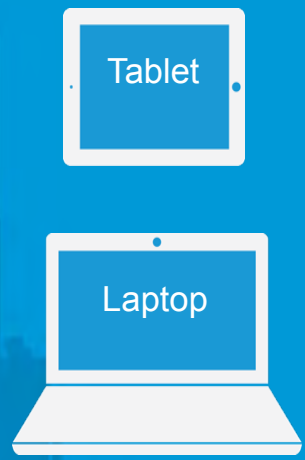
ASHRAE BACnet™

- Building/energy management systems (BMS/EMS)
- Energy dashboards & analytics packages
- Maintenance & work order management systems
- HVAC
- Fire & safety
- Access & security
- Audio & video
- Metering
- IT

Energi TriPak® Hub

Contractor-friendly with easy setup





Intuitive software works on any device!

Energi TriPak® Hub

Works for any size building

Small retail

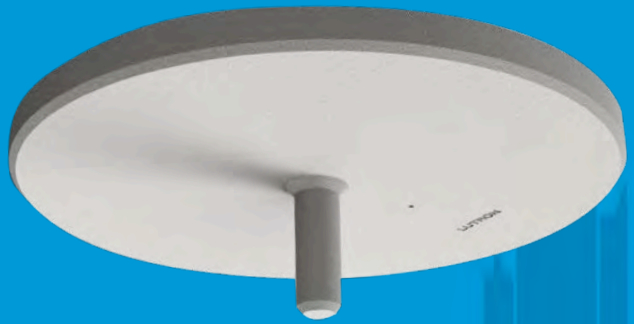
School & University

Municipality & Government

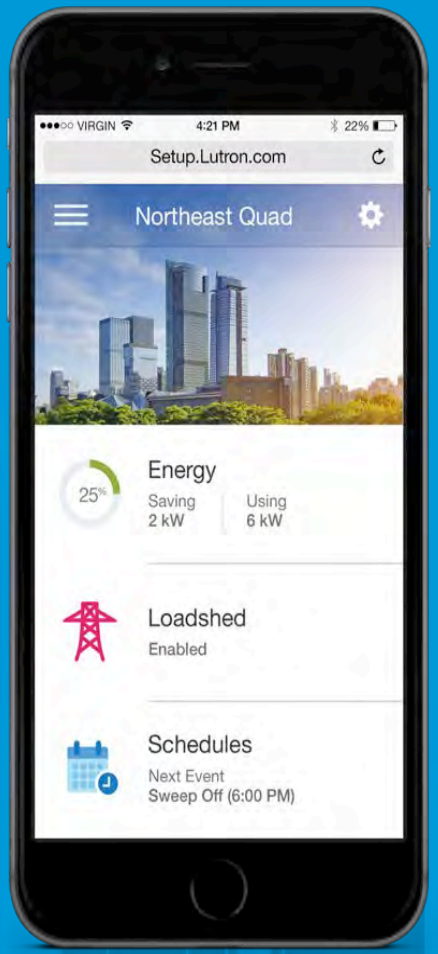
Large commercial office building

Energi TriPak® Hub

- Launch:
  September 2015
- Ship:
  Q1 2016



Energi TriPak Hub



The Opportunity

Lighting energy audits take a long time and a lot of expertise….

Generating energy proposals takes even longer and even MORE expertise…

LUTRON®

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Advanced Lighting Control

- Central Control
- BACnet Integration to BMS
- MicroGrid
- Demand Responds

LUTRON®

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Energi Savr Node (ESN)

- Intelligent, networkable, distributed lighting control solution that helps maximize energy savings
- Easily combines daylighting, occupancy/vacancy sensing, personal control, and timeclock
- Programmed via mobile device
- 3 Versions
  - Switching
  - 0-10V
  - EcoSystem

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Energi Savr Node with EcoSystem

- Connect up to 64 or 128 EcoSystem-compatible ballasts or LED drivers
- Share sensors and controls across EcoSystem links and Energi Savr Node modules
- Re-configure spaces quickly and easily without any re-wiring
- Easier installation - control wires can be run as Class 1 or Class 1
- Connect up to 8 EcoSystem links together to control up to 512 ballasts/drivers from one control

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QS Sensor Module (QSM)

10 of <u>each</u> wireless Device

QS Link

QS Sensor Module

LUTRON

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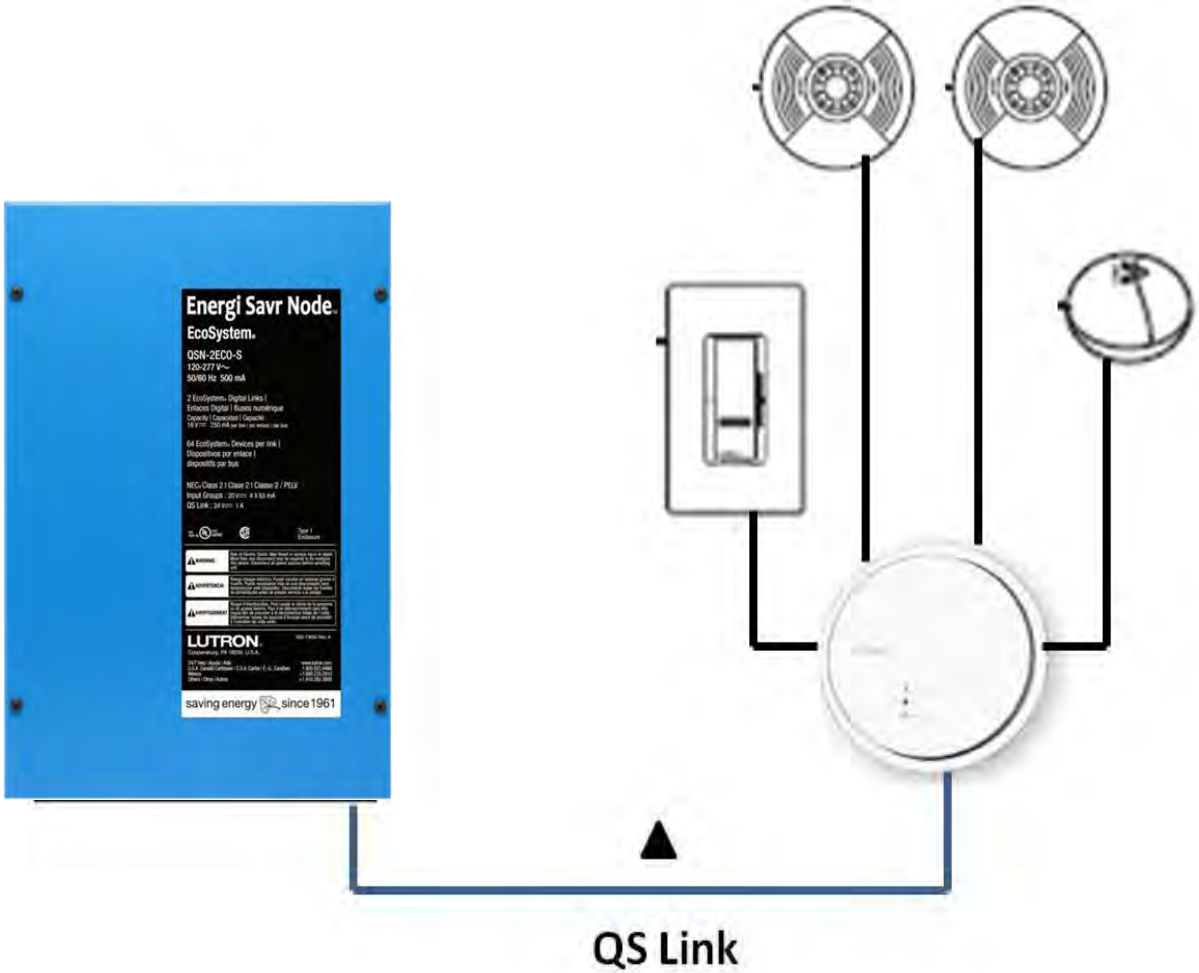
QS Sensor Module (QSM)



4 Wired Inputs
(Not Groups)

4 Wired Groups
To Each ESN

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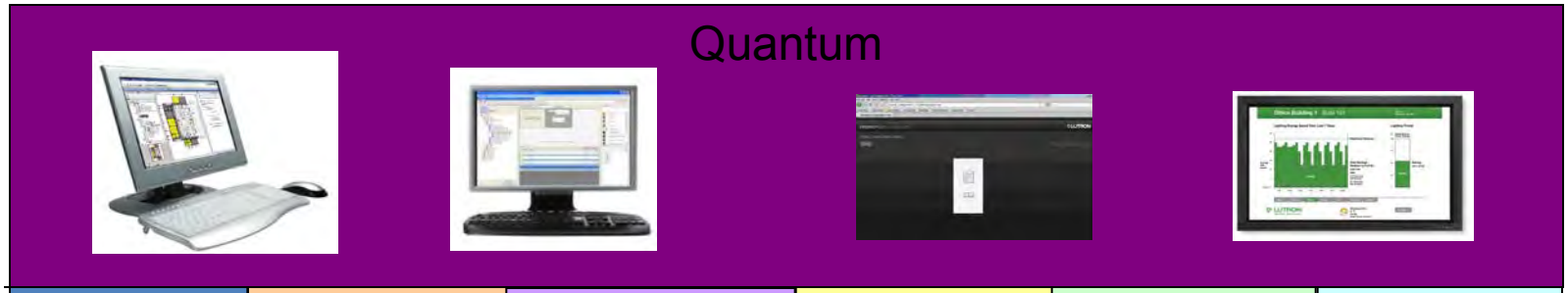
What is Quantum?

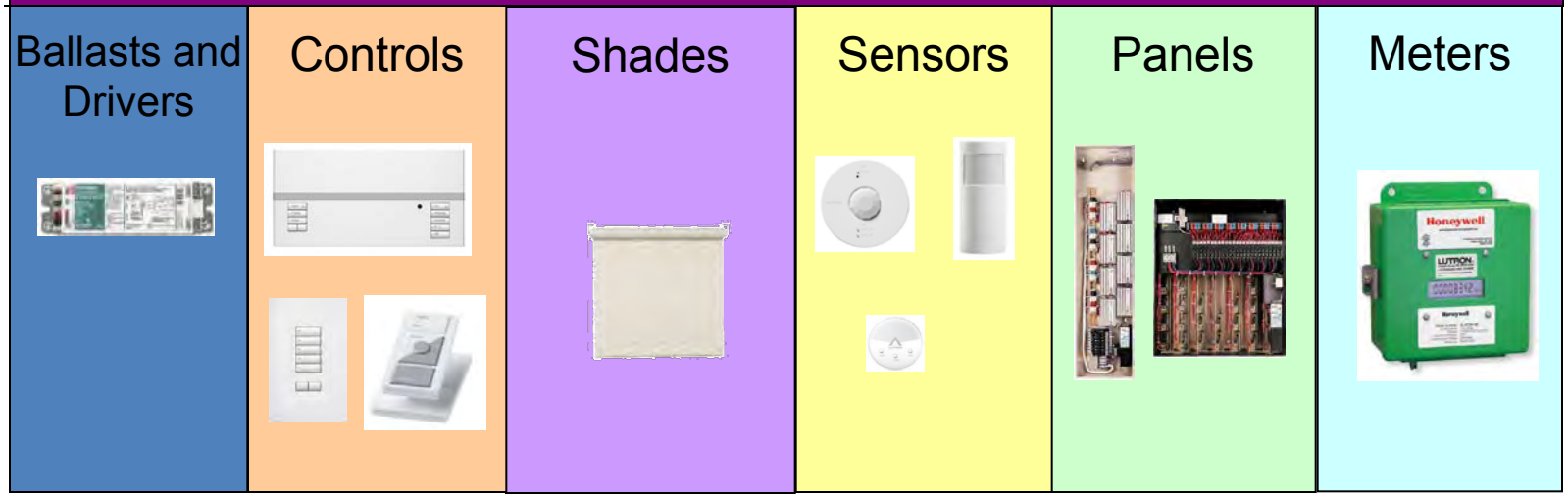
Another Layer of Intelligence:

- Adds additional features to independent systems
- Lets independent systems share functionality

Quantum Control and Monitor Layer



System Layer



LUTRON

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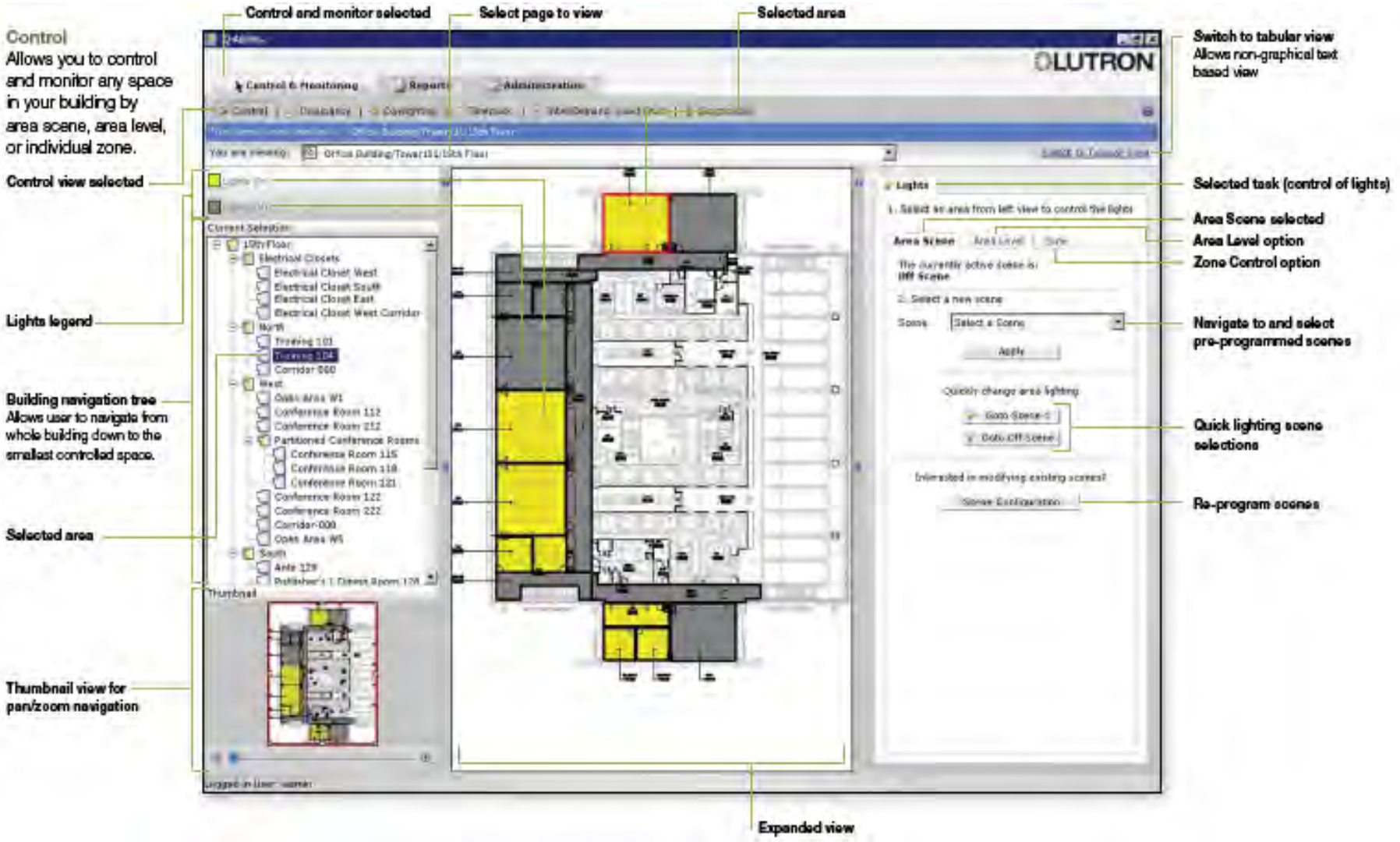
Facility Manager Software – Q-Admin

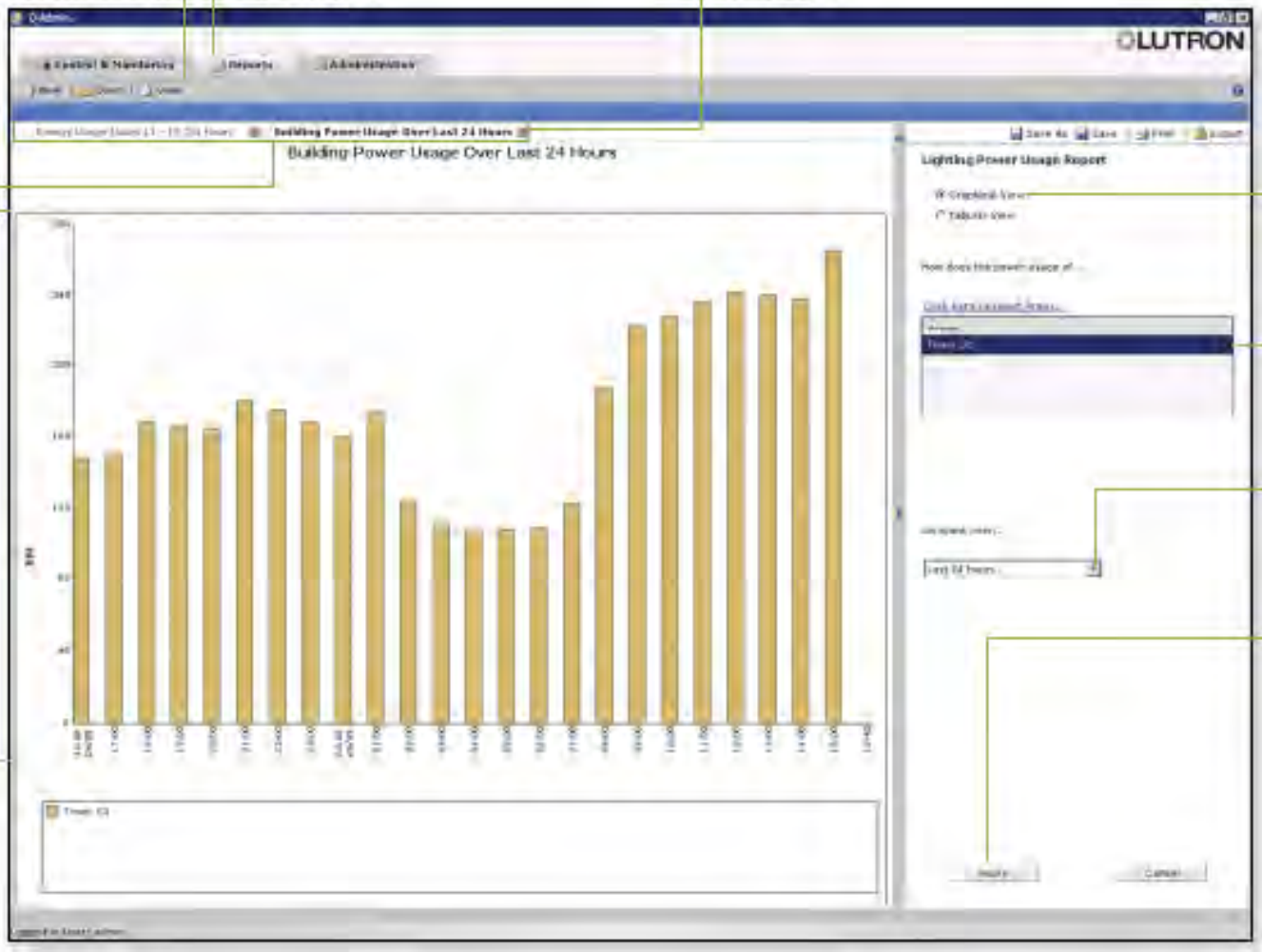


LUTRON®

energy

Q-Admin Software - Reports

Power usage
Allows you to monitor lighting power usage in the whole building or any part of the building.

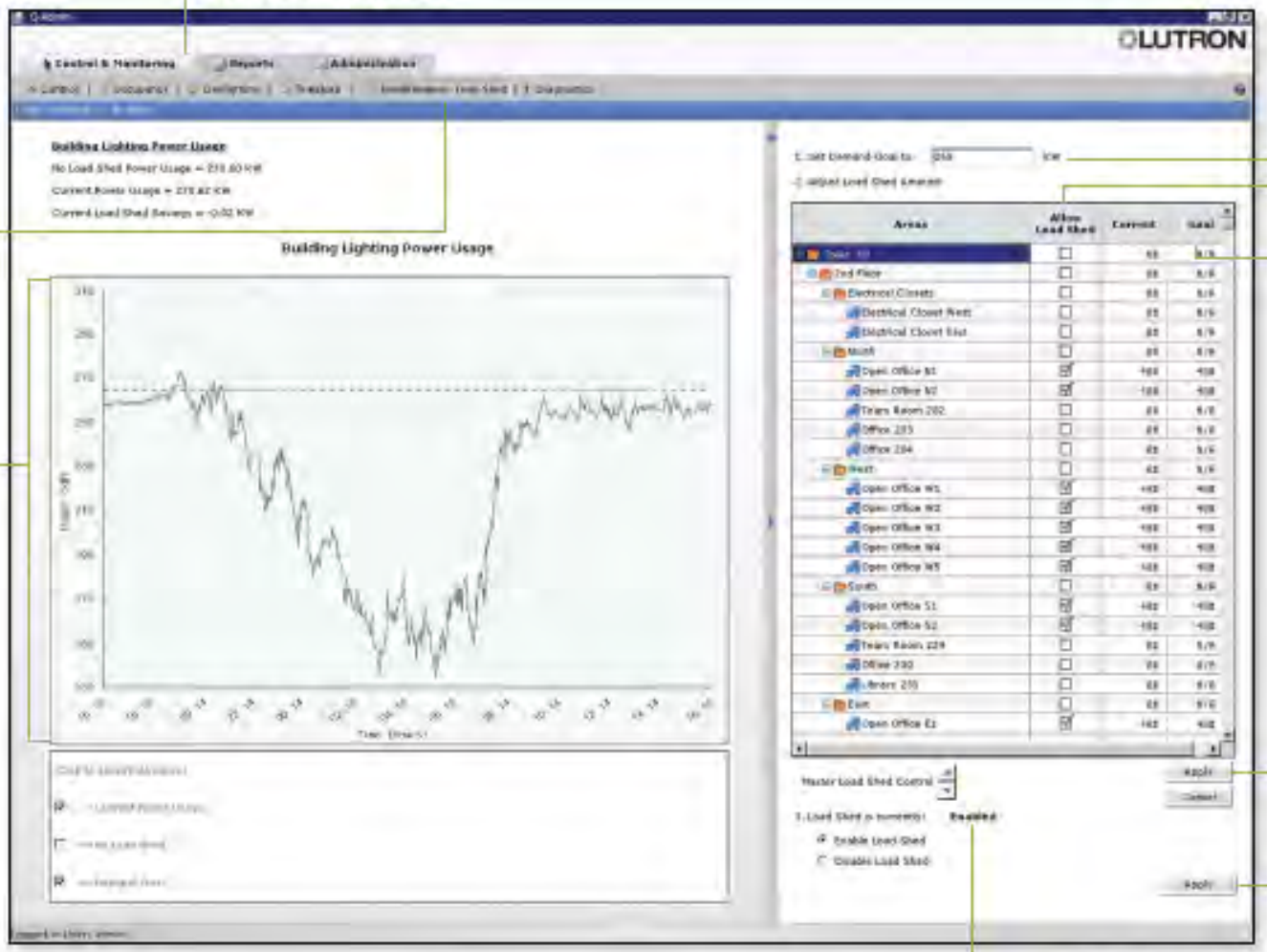


LUTRON®

save energy

Q-Admin – IntelliDemand$_{TM}$ Load Shed

IntelliDemand load shed
Allows you to monitor the lighting power usage and shed lighting load when necessary.



IntelliDemand load shed selected

Building power usage

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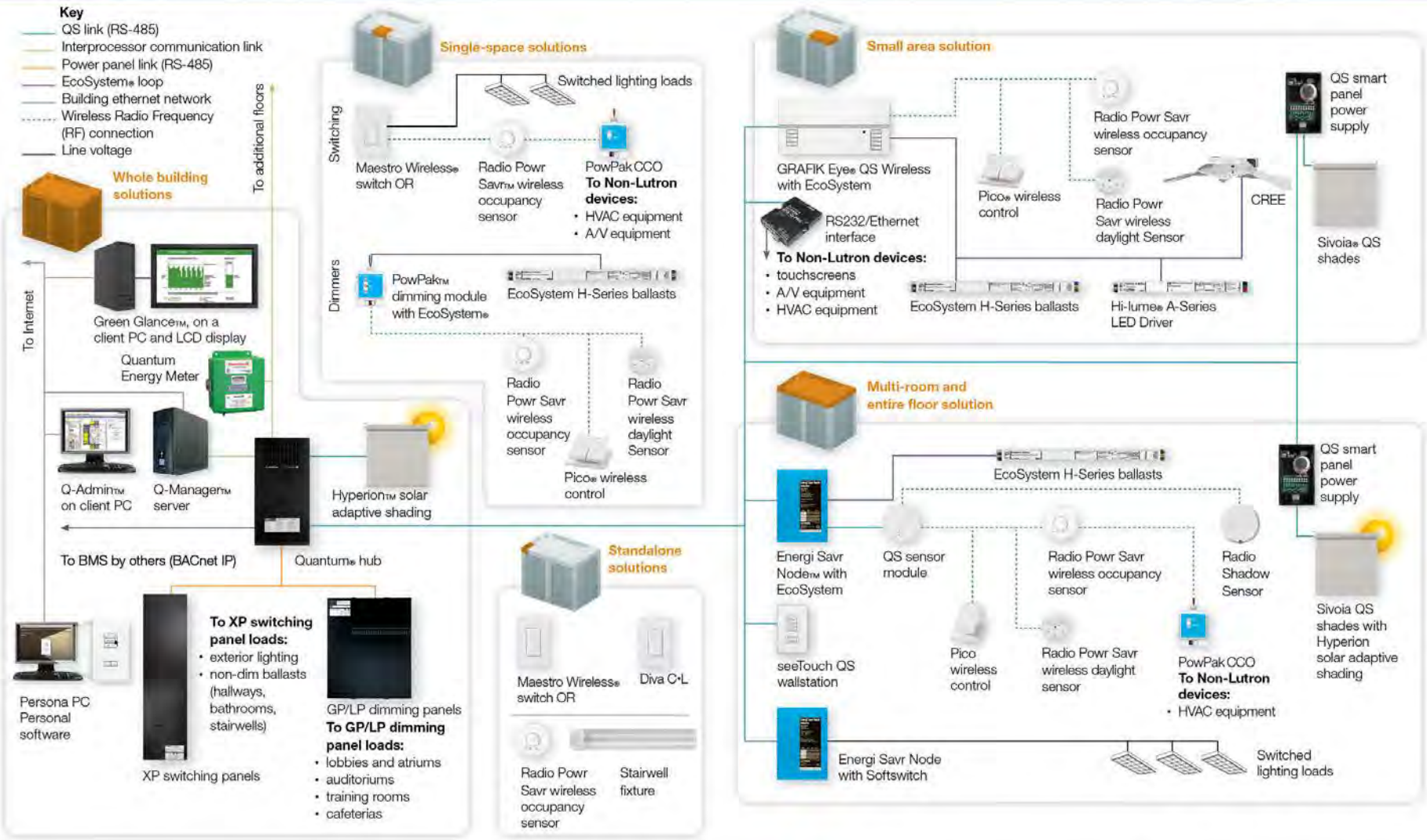
How it all works together



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How can Lutron help you with your Energy Projects?

- **Train you on Lutron advanced lighting controls**
- **Support site visits/identify advanced ECMs on your projects**
- **Develop Energy Proposals including:**
  - **Budgetary Estimates and Incentives**
- **Support lighting control design during IGA phase**
- **Support installation and start-up**
- **Support re-commissioning**

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Questions?

Thank you,

Michael Matour

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