Codes and Controls

Commercial building energy and green code requirements for lighting controls

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Learning Objectives

- By reviewing U.S. Department of Energy data, the participant will be able to describe the importance of energy conservation in buildings and how light control significantly helps.
- Using several light control strategies, the participant will be able to explain how light control saves energy in commercial buildings.
- By reviewing commercial building energy codes requirements, the participant will be able to determine how light control helps meets those requirements.
- Through examination of the provided real world case studies, the participant will be able to describe how they used lighting controls to save energy.

Why is energy important?

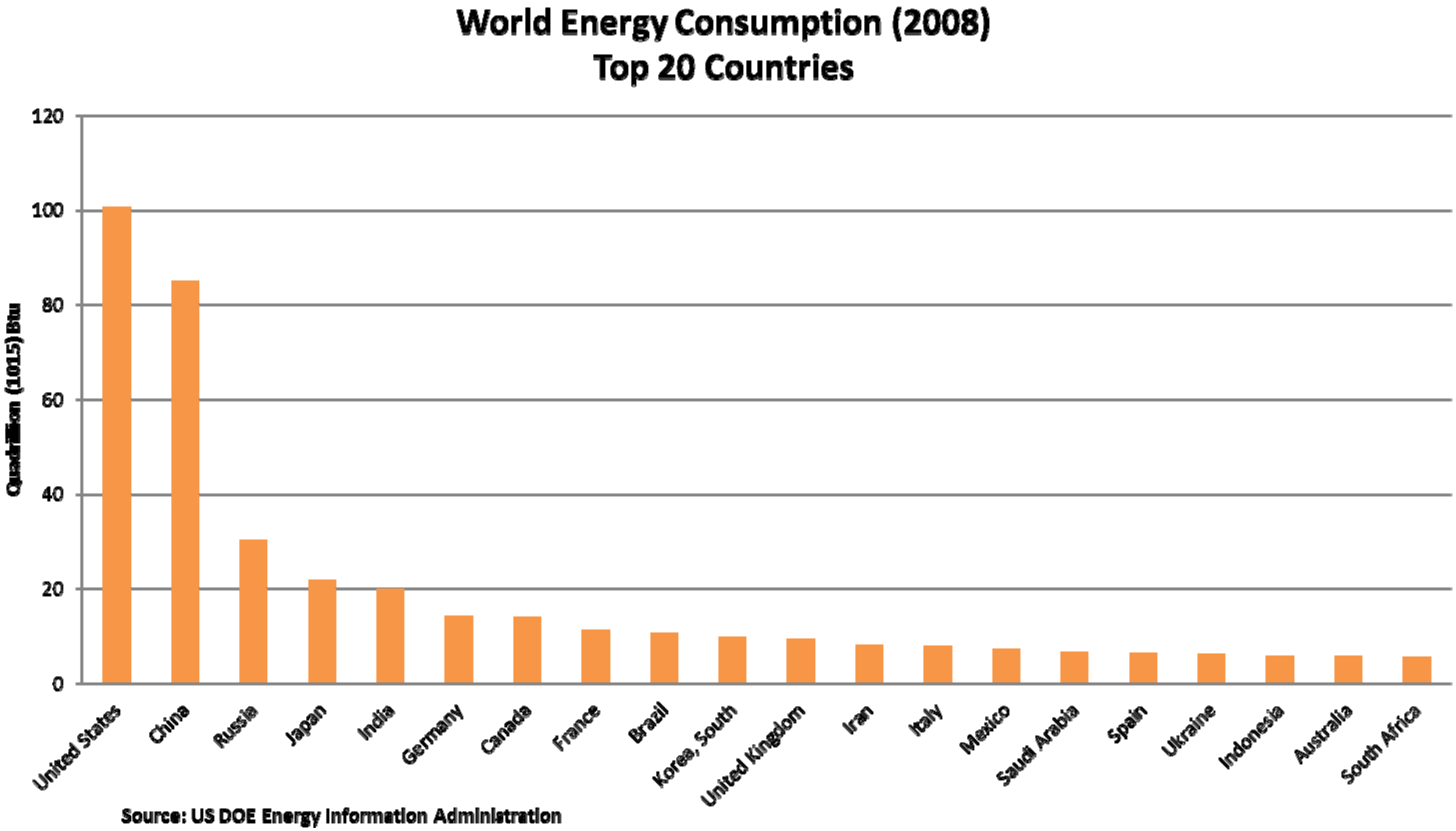
Humanity's Top Ten Problems over Next 50 Years:

1. Energy
2. Water
3. Food
4. Environment
5. Poverty
6. Terrorism and War
7. Disease
8. Education
9. Democracy
10. Population

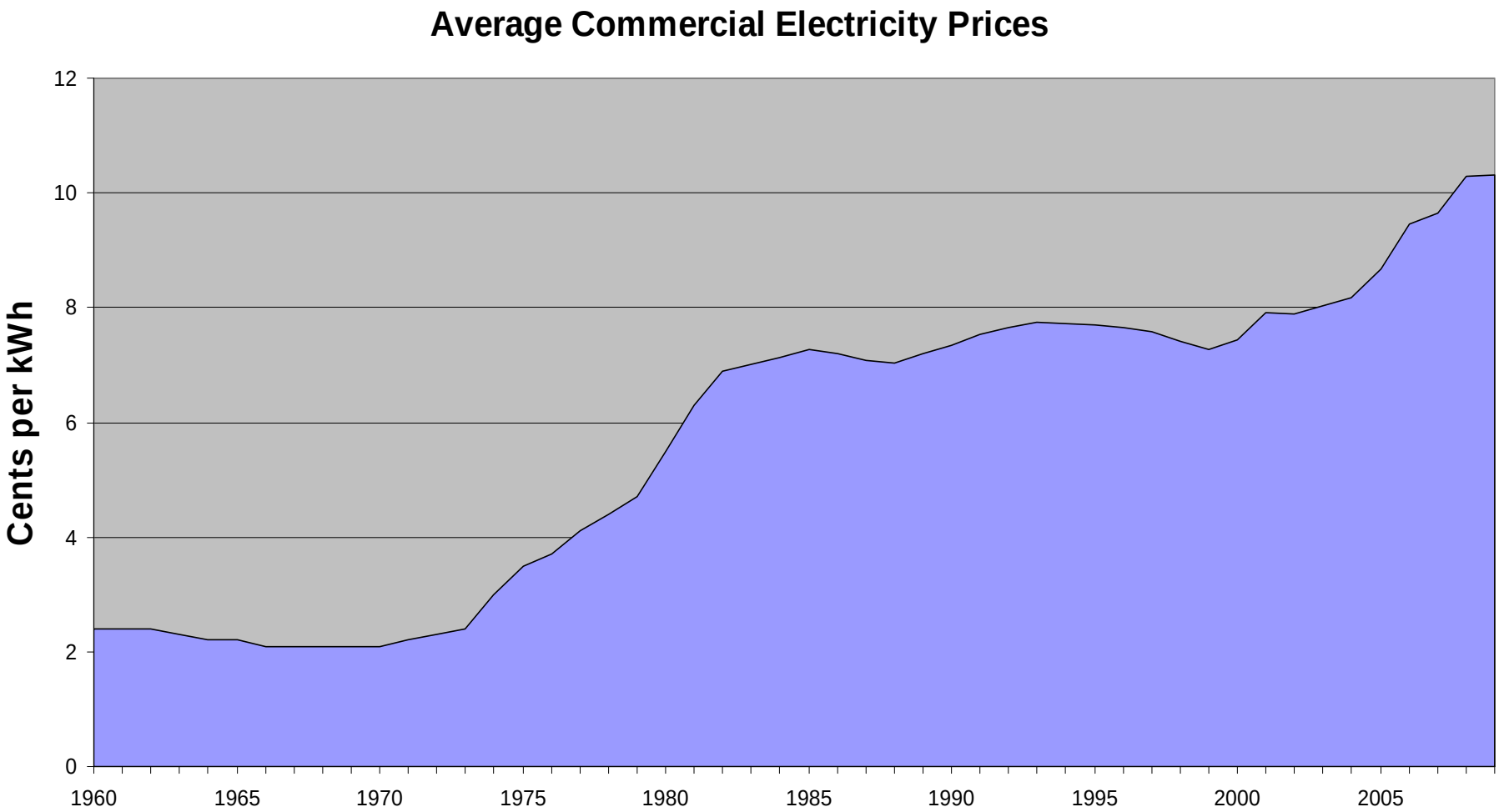
Source: Richard Smalley, 1996 Noble Laureate in Chemistry

2011: 7 Billion People
2050: 10 Billion People

Big picture – world energy usage



Big picture – increasing energy prices



Source: US Dept. of Energy, Energy Information Administration

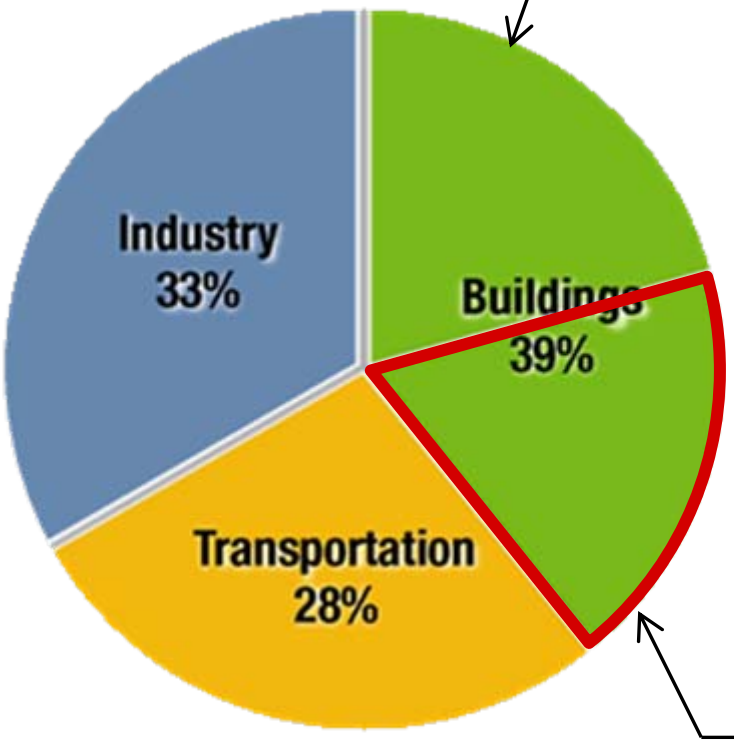
Big picture – conservation

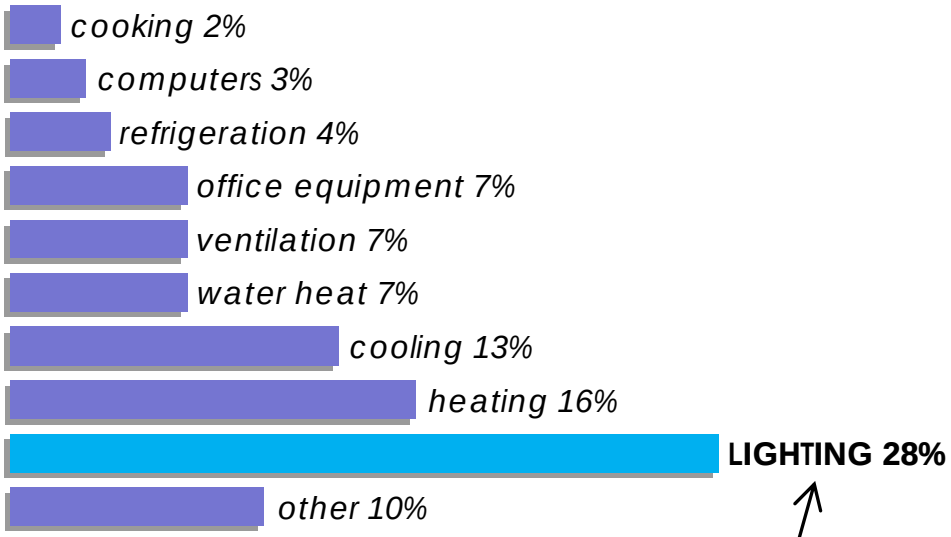
"The biggest gains in terms of decreasing the country's energy bill, the amount of carbon dioxide we put into the atmosphere, and our dependency on foreign oil, will come from energy efficiency and conservation in the next 20 years."

Steven Chu
Secretary of Energy

Big picture – Why Focus on Lighting?

Buildings consume 39% of total U.S. primary energy



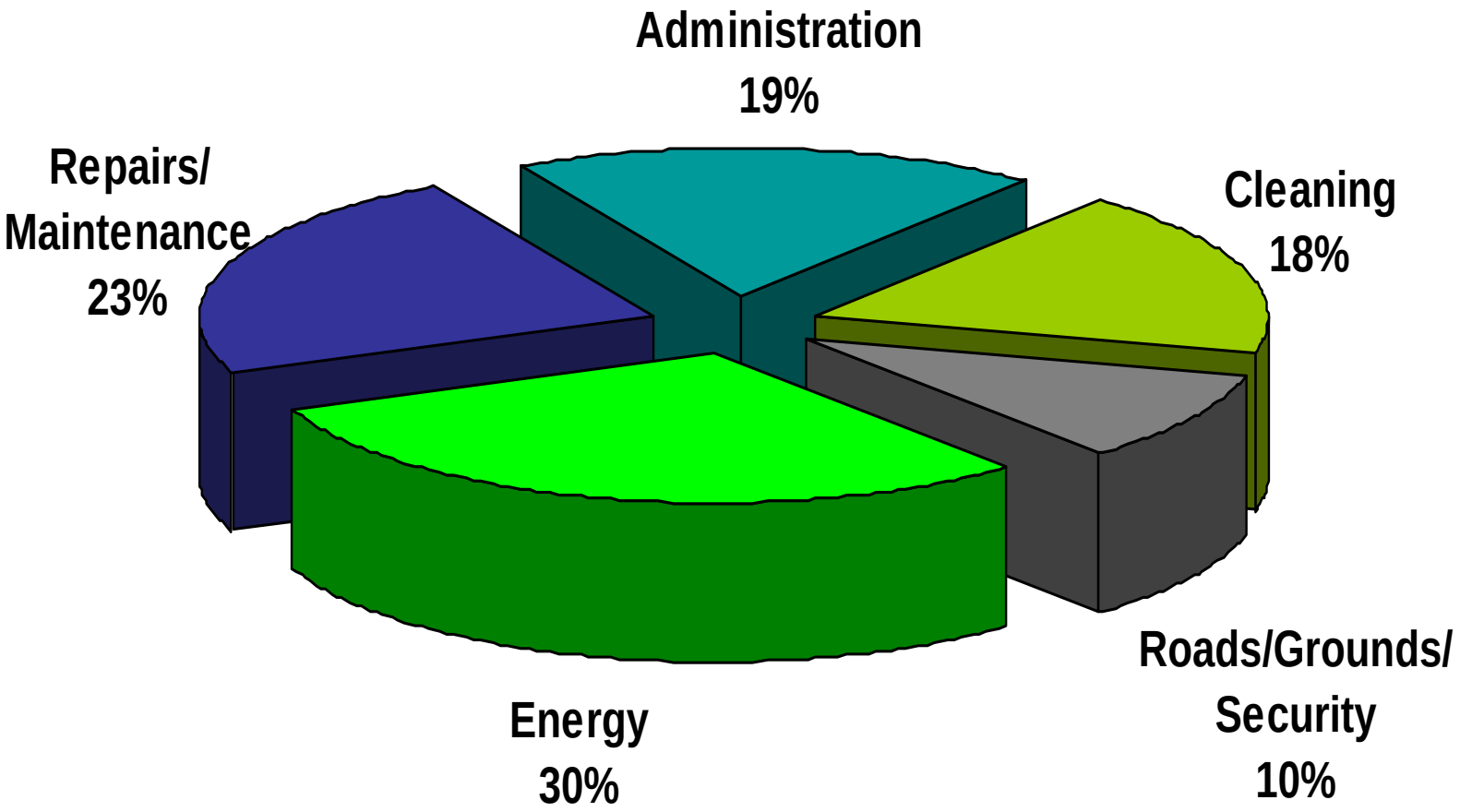


Commercial Buildings

Lights use the most energy

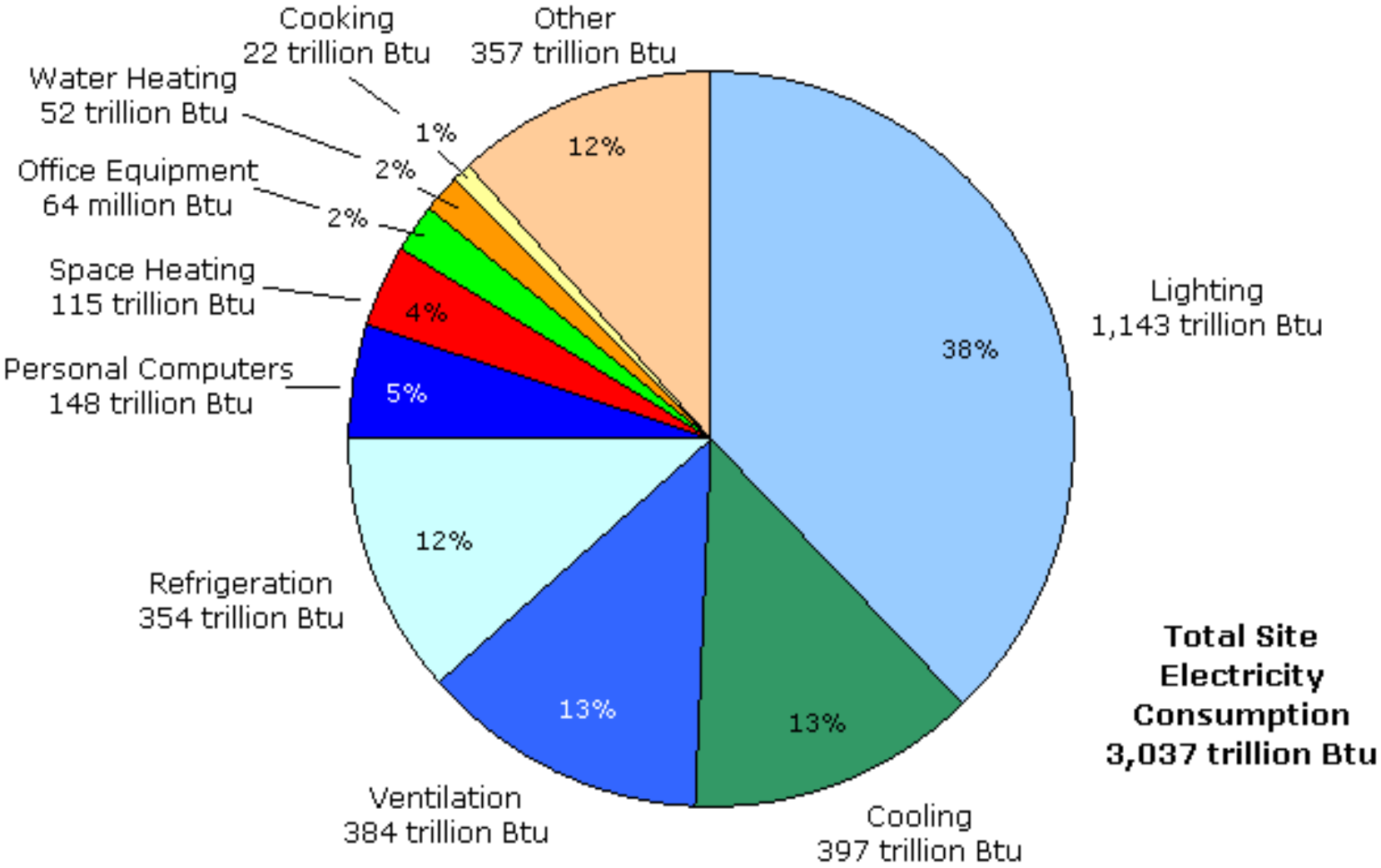
Source: U.S. DOE

Energy is the largest operating expense for commercial buildings



Source: U.S. EPA

More site electricity is consumed for lighting than for any other end use.



Source: U.S. DOE

Problem: Wasted lighting energy

Buildings:

- Are over-illuminated
- Don't take into account daylight
- Leave lights on in vacant spaces or after operating hours
- 75% were built before 1989
- Inability to modify lighted environment to meet needs

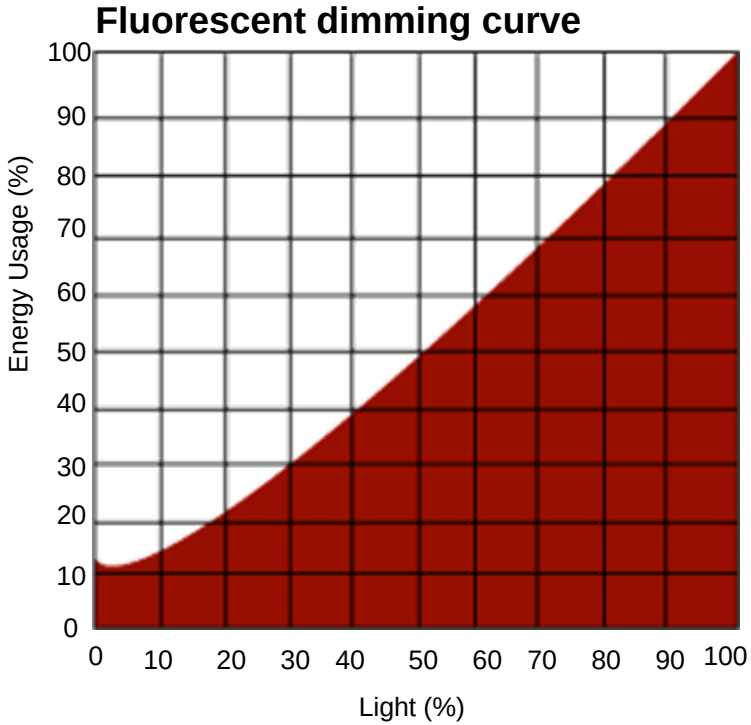
What's wrong with this picture?

"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

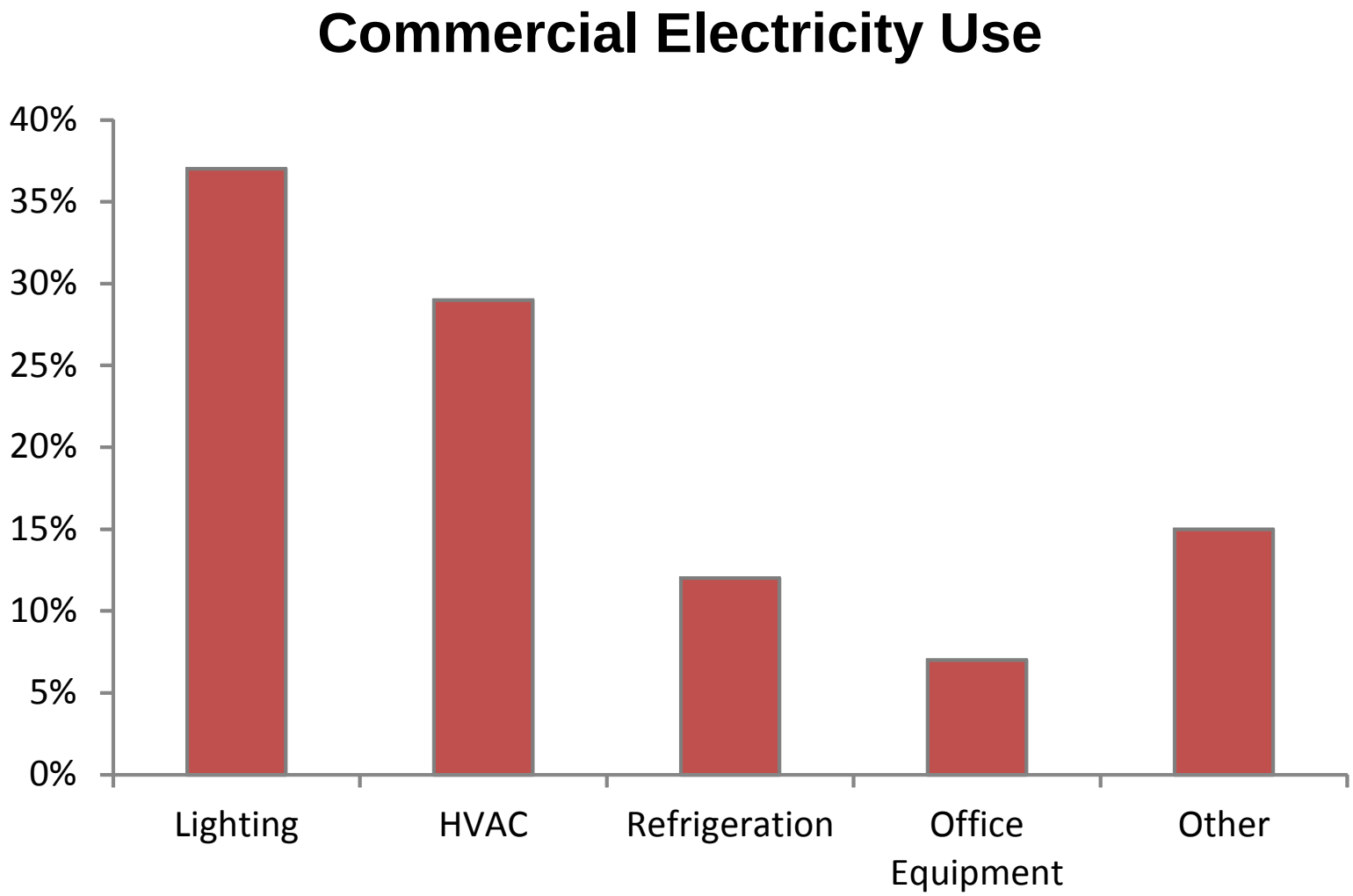
Solution: Light control

Primary ways light control saves energy:

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

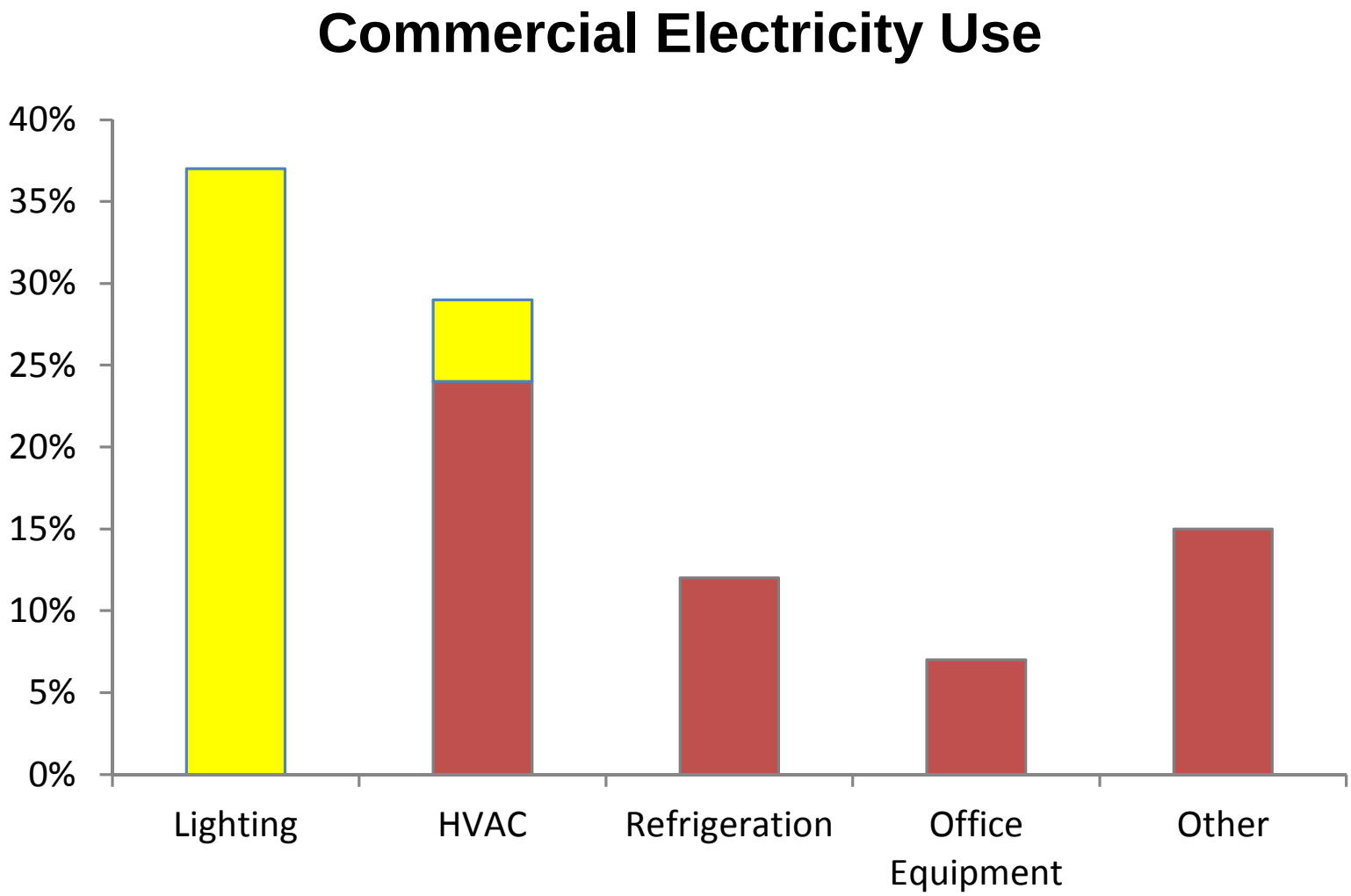


Lighting Electricity Use



Source: http://www.eia.gov/emeu/cbecs/cbecs2003/lighting/lighting1.html

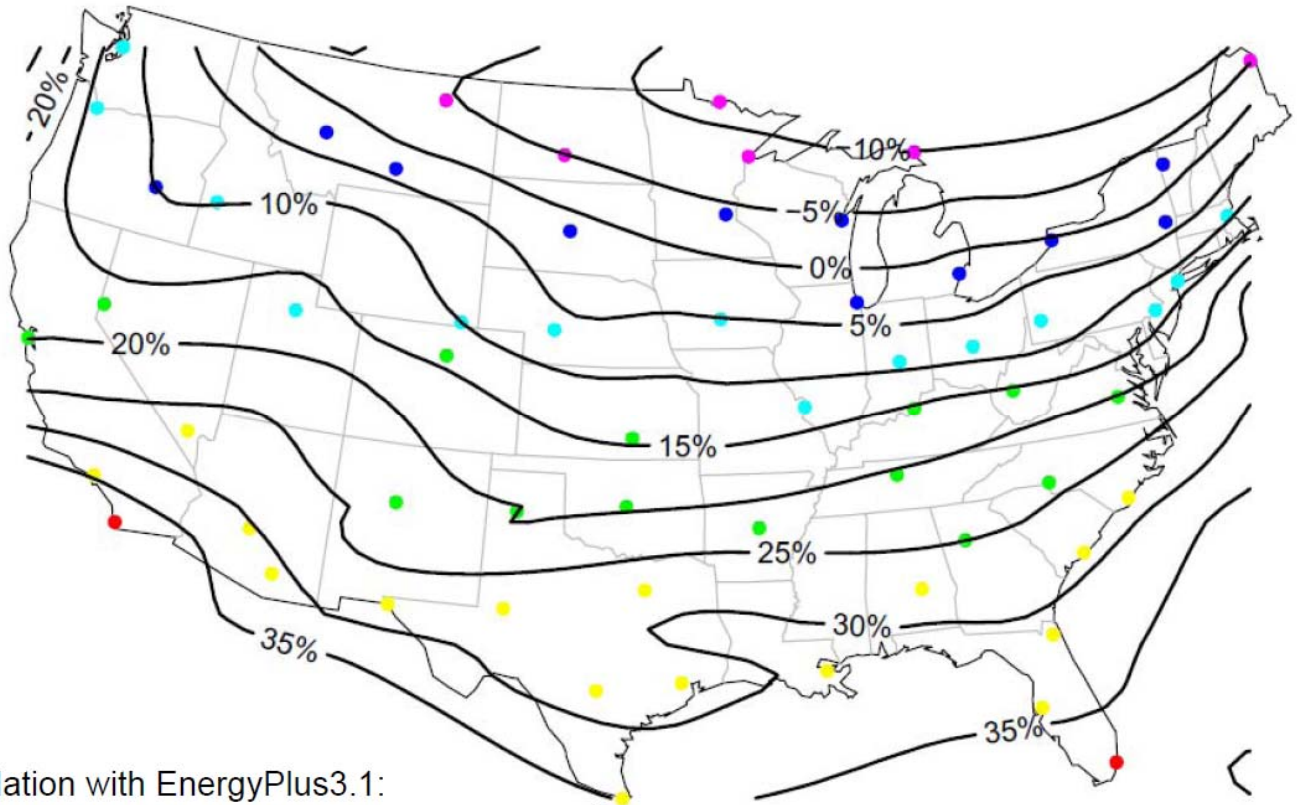
Lighting Electricity Use



Source: http://www.eia.gov/emeu/cbecs/cbecs2003/lighting/lighting1.html

Lighting Electricity Use

Additional incremental savings in total building energy consumption when lighting energy consumption is reduced



Simulation with EnergyPlus3.1:
Medium sized 3-story office building (6,144m^2),
40% window-wall-ratio,
Packaged terminal air conditioner,
standard wall insulation (ASHRAE 90.1-2004)

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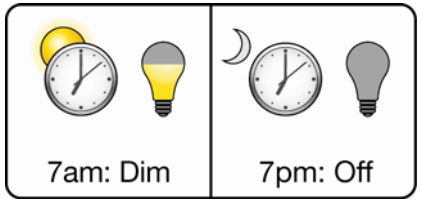
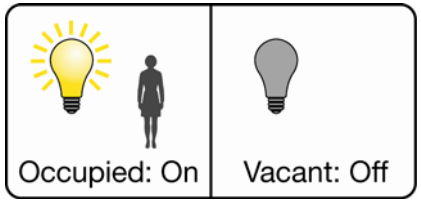
Created by Pekka Hakkarainen, Ph.D.
Complaints to phakkarainen@lutron.com

Value of Basic Lighting Control



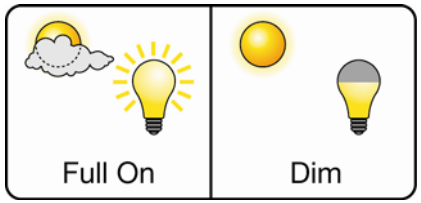
Scheduling: Lights automatically turn off or are dimmed at certain times of the day or based on sunrise or sunset.
SAVE 10-20%[1]



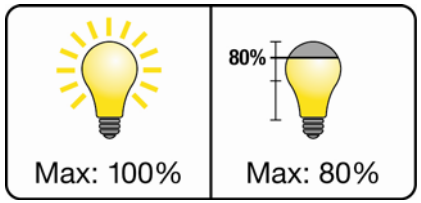
Occupancy/Vacancy Sensing: Automatically turn off lights when people vacate the space.
SAVE 20-60%[1]

[1] VonNieda B, Maniccia D, & Tweed A. 2000. An analysis of the energy and cost savings potential of occupancy sensors for commercial lighting systems. Proceedings of the Illuminating Engineering Society. Paper #43. Scheduling savings based on achieving 50% reduction in after-hours energy waste.

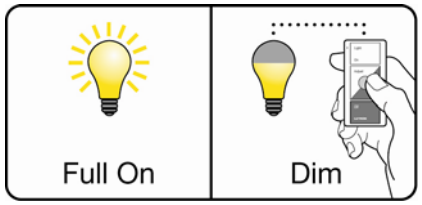
Value of Advanced Lighting Control



Daylight Harvesting: Automatically adjust light levels based on the amount of daylight in the space.
SAVE 25-60%[1]



High end trim/Tuning: Set target light level based on occupant requirements in the space.
SAVE 10-20%[2]



Personal Light Control: Allows users in the space to select the correct light levels for the task.
SAVE 10-20%[3]

[1] Brambley MR, et al. 2005. Advanced sensors and controls for building applications: Market assessment and potential R&D pathways. Pacific Northwest National Laboratory: prepared for U.S. Department of Energy.

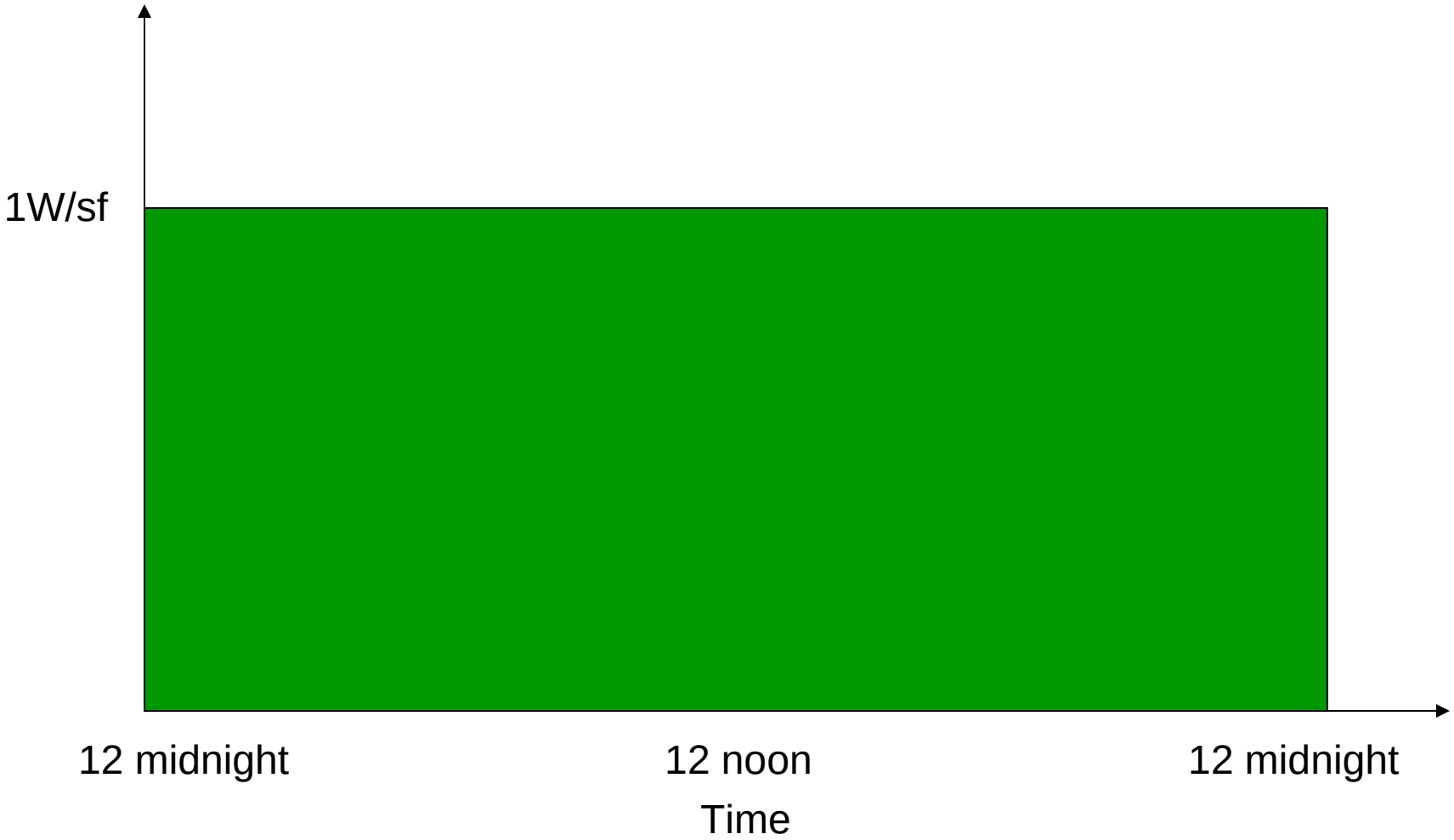
[2] Pacific Gas and Electric Company. 1997. Dimming Controls for Lighting.

[3] Galasiu AD, et al. 2007. Energy saving lighting control systems for open-plan offices: A field study. Leukos. 4(1) pg. 7-29.

Combined Strategy Energy Savings

Lighting Power Used

Annual energy consumption = 8.76 kWh / sf

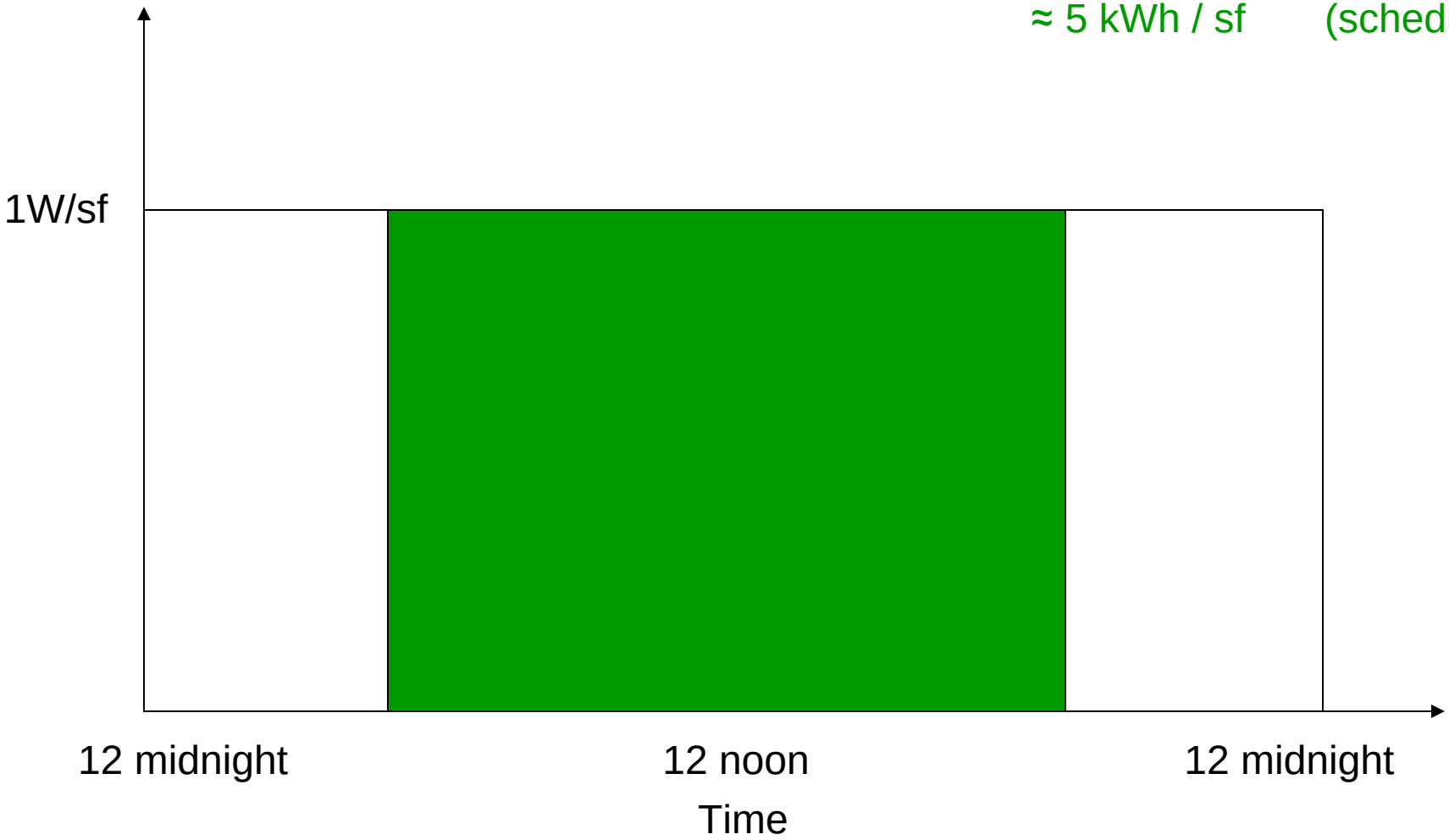


Combined Strategy Energy Savings

Lighting Power Used

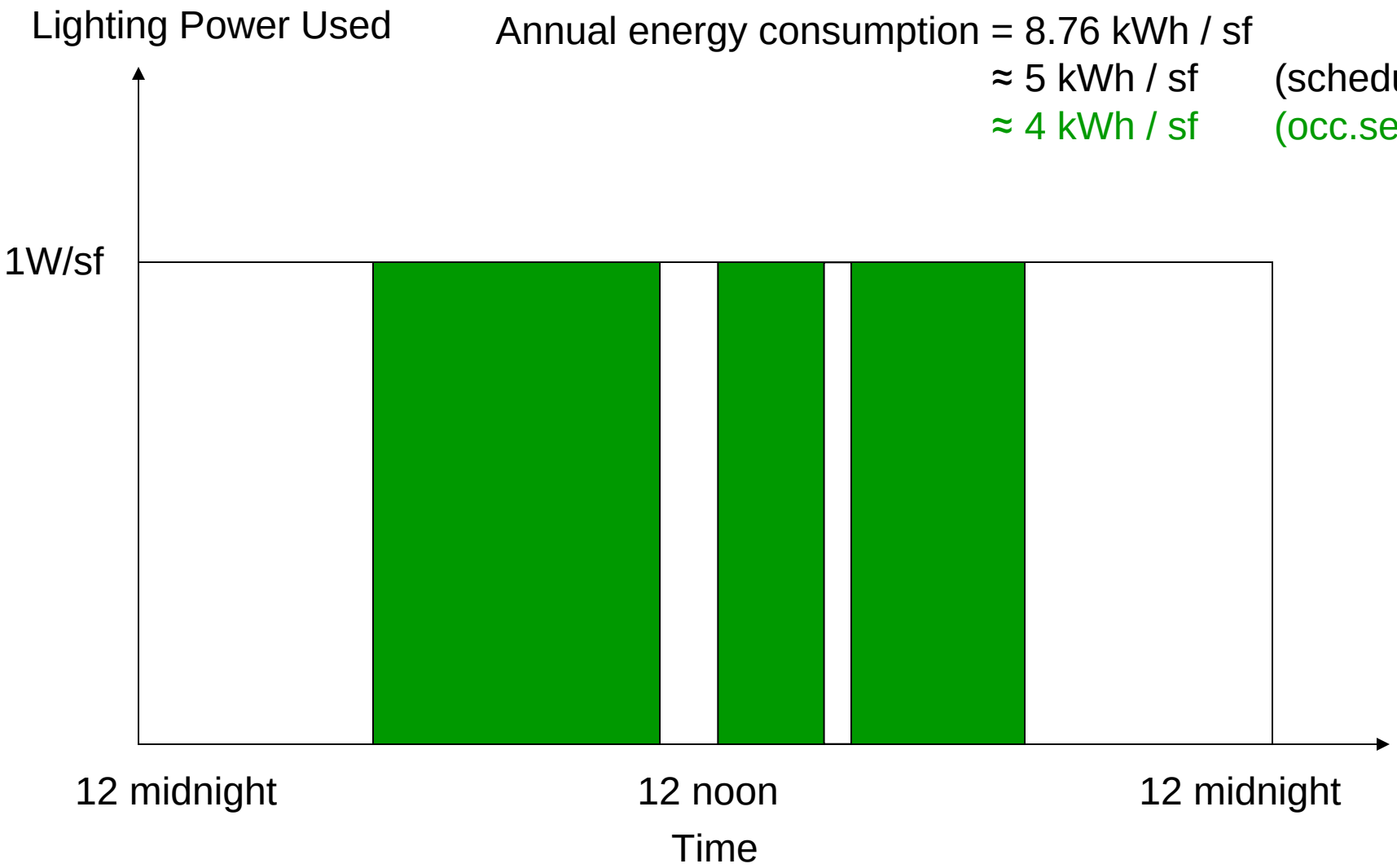
Annual energy consumption = 8.76 kWh / sf

≈ 5 kWh / sf (scheduling)



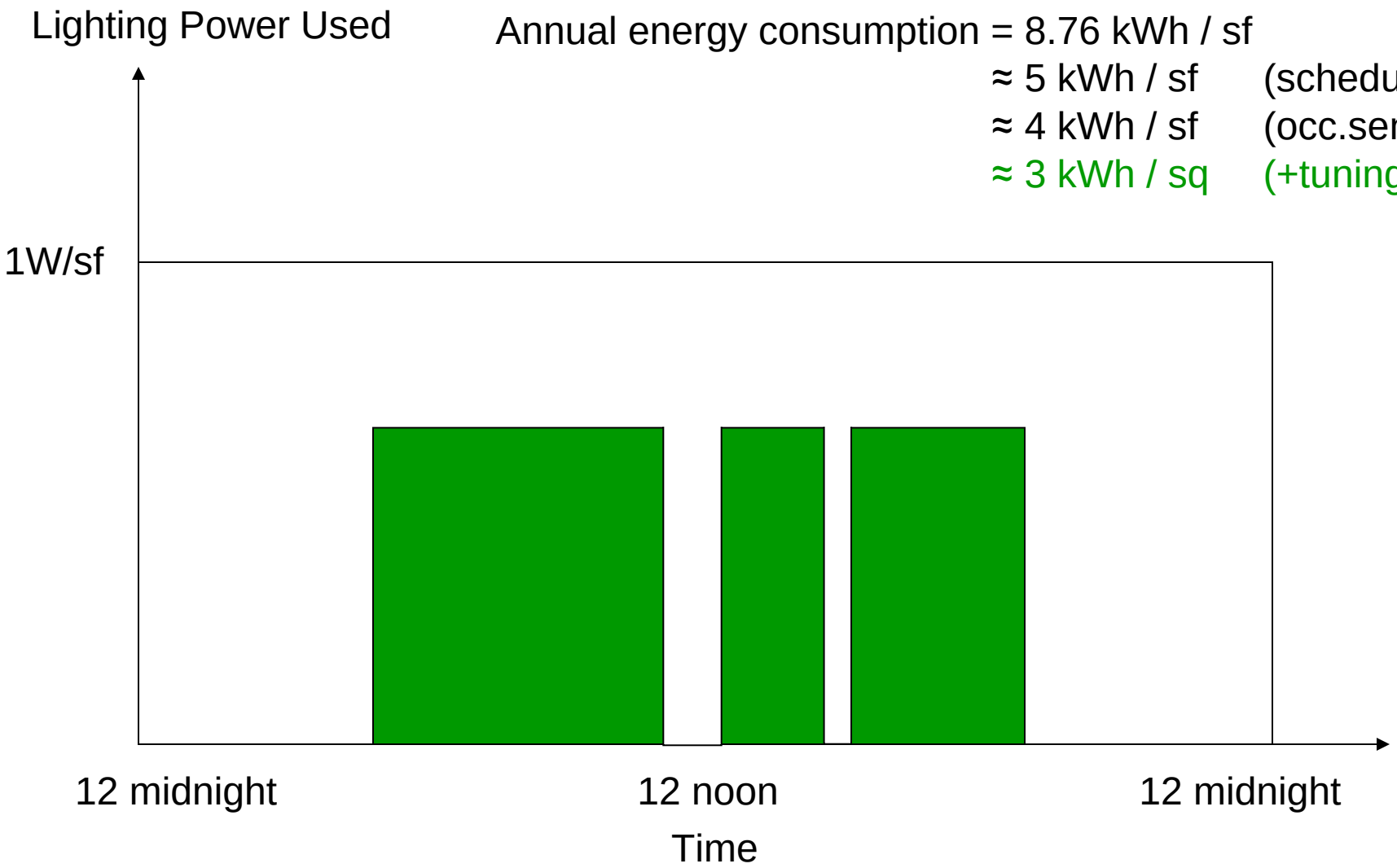
Combined Strategy Energy Savings

Annual energy consumption = 8.76 kWh / sf
≈ 5 kWh / sf (scheduling)
≈ 4 kWh / sf (occ.sens.)



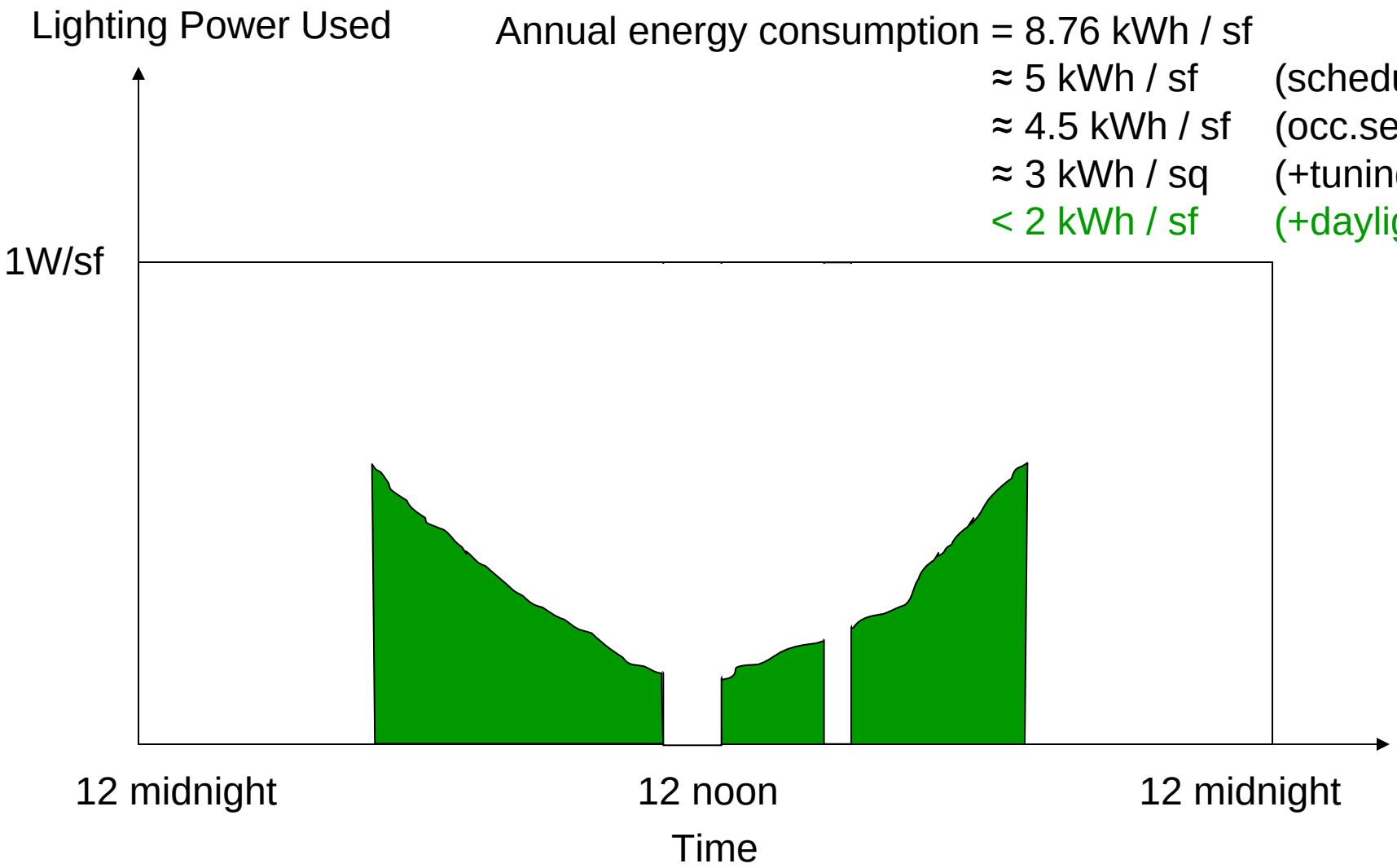
Combined Strategy Energy Savings

Annual energy consumption = 8.76 kWh / sf
≈ 5 kWh / sf (scheduling)
≈ 4 kWh / sf (occ.sens.)
≈ 3 kWh / sq (+tuning)



Combined Strategy Energy Savings

Annual energy consumption = 8.76 kWh / sf
≈ 5 kWh / sf (scheduling)
≈ 4.5 kWh / sf (occ.sens.)
≈ 3 kWh / sq (+tuning)
< 2 kWh / sf (+daylight)



Value of Lighting Control

Scheduling

Occupancy/Vacancy Sensing

High-end trim/Tuning

Daylight Harvesting

Personal Light Control

Value of Lighting Control

Basic System
Combined Savings ~ 40%

Scheduling

Occupancy/Vacancy Sensing

High-end trim/Tuning

Daylight Harvesting

Personal Light Control

Value of Lighting Control

High Performance System

Combined Savings ~ 65%

Scheduling

Occupancy/Vacancy Sensing

High-end trim/Tuning

Daylight Harvesting

Personal Light Control

Comparing Basic to Advanced Control

- Is the improvement from basic to advanced as simple as 40% energy savings (BASIC) to 65% energy savings (ADVANCED)?

Comparing Basic to Advanced Control

- Example (One month period):
  - 1000ft² Space
  - 1.0 W/ft² lighting
  - 300 hours monthly use
  - $0.20 /kWh
  - $40 /kW peak load

You have $100 to pay lighting utilities ● A	You spend $25 for a Basic Lighting Control System ● B	You spend $65 for an Advanced Lighting Control System ● C

Comparing Basic to Advanced Control

- Example (One month period):
  - 1000ft² Space
  - 1.0 W/ft² lighting
  - 300 hours monthly use
  - $0.20 /kWh
  - $40 /kW peak load

You have $100 to pay lighting utilities

A

<u>Monthly lighting use:</u>

Energy use = 1000ft² x 1 W/ft² x 300 h

= 300,000 Wh = 300 kWh

Peak power = 1000ft² x 1 W/ft²

= 1000 W = 1kW

Comparing Basic to Advanced Control

- Example (One month period):
  - 1000ft² Space
  - 1.0 W/ft² lighting
  - 300 hours monthly use
  - $0.20 /kWh
  - $40 /kW peak load

You have $100 to pay lighting utilities

A

<u>Monthly lighting costs:</u>

Energy payment = 300 kWh x $0.20 /kWh

= $60

Peak power payment = 1kW x $40

= $40

Comparing Basic to Advanced Control

- Example (One month period):
  - 1000ft² Space
  - 1.0 W/ft² lighting
  - 300 hours monthly use
  - $0.20 /kWh
  - $40 /kW peak load

You spend $25 for a Basic Lighting Control System

B

<u>Monthly lighting use:</u>

Energy use = 300 kWh x 60% (40% saved)

= 180 kWh

Peak power = 1000ft² x 1 W/ft²

= 1000 W = 1kW

Comparing Basic to Advanced Control

- Example (One month period):
  - 1000ft² Space
  - 1.0 W/ft² lighting
  - 300 hours monthly use
  - $0.20 /kWh
  - $40 /kW peak load

You spend $25 for a Basic Lighting Control System

B

<u>Monthly lighting costs:</u>

Energy payment = 180 kWh x $0.20 /kWh

~ $35

Peak power payment = 1kW x $40

= $40

Comparing Basic to Advanced Control

- Example (One month period):
  - 1000ft² Space
  - 1.0 W/ft² lighting
  - 300 hours monthly use
  - $0.20 /kWh
  - $40 /kW peak load

You spend $65 for an Advanced Lighting Control System

C

<u>Monthly lighting use:</u>

Energy use = 300 kWh x 35% (65% savings)

= 105 kWh

Peak power = 1kW x 35% (65% savings)

= 0.35 kW

Comparing Basic to Advanced Control

- Example (One month period):
  - 1000ft² Space
  - 1.0 W/ft² lighting
  - 300 hours monthly use
  - $0.20 /kWh
  - $40 /kW peak load

You spend $65 for an Advanced Lighting Control System

C

<u>Monthly lighting costs:</u>

Energy payment = 105 kWh x $0.20 /kWh

~ $20

Peak power payment = 0.35kW x $40

~ $15

Comparing Basic to Advanced Control

	A	B	C
Starting Cash	$ 100.00	$ 75.00	$ 35.00
kWh Payment	$ 60.00	$ 35.00	$ 20.00
kW Payment	$ 40.00	$ 40.00	$ 15.00
Remaining Cash	**$ -**	**$ -**	**$ -**

Comparing Basic to Advanced Control

	A	B	C
Starting Cash	$ 100.00	$ 75.00	$ 35.00
kWh Payment	$ 60.00	$ 35.00	$ 20.00
kW Payment	$ 40.00	$ 40.00	$ 15.00
Remaining Cash	**$ -**	**$ -**	**$ -**
Cost Savings	**$ -**	**$ 25.00**	**$ 65.00**

Comparing Basic to Advanced Control

	A	B	C
Starting Cash	$ 100.00	$ 75.00	$ 35.00
kWh Payment	$ 60.00	$ 35.00	$ 20.00
kW Payment	$ 40.00	$ 40.00	$ 15.00
Remaining Cash	**$ -**	**$ -**	**$ -**
Cost Savings	**$ -**	**$ 25.00**	**$ 65.00**
	20%	**20%**	**20%**
HVAC BONUS	**$ -**	**$ 5.00**	**$ 15.00**

Comparing Basic to Advanced Control

	A	B	C
Starting Cash	$ 100.00	$ 75.00	$ 35.00
kWh Payment	$ 60.00	$ 35.00	$ 20.00
kW Payment	$ 40.00	$ 40.00	$ 15.00
Remaining Cash	**$ -**	**$ -**	**$ -**
Cost Savings	**$ -**	**$ 25.00**	**$ 65.00**
	20%	**20%**	**20%**
HVAC BONUS	$ -	$ 5.00	$ 15.00
Total Savings	**$ -**	**$ 30.00**	**$ 80.00**

More than energy savings

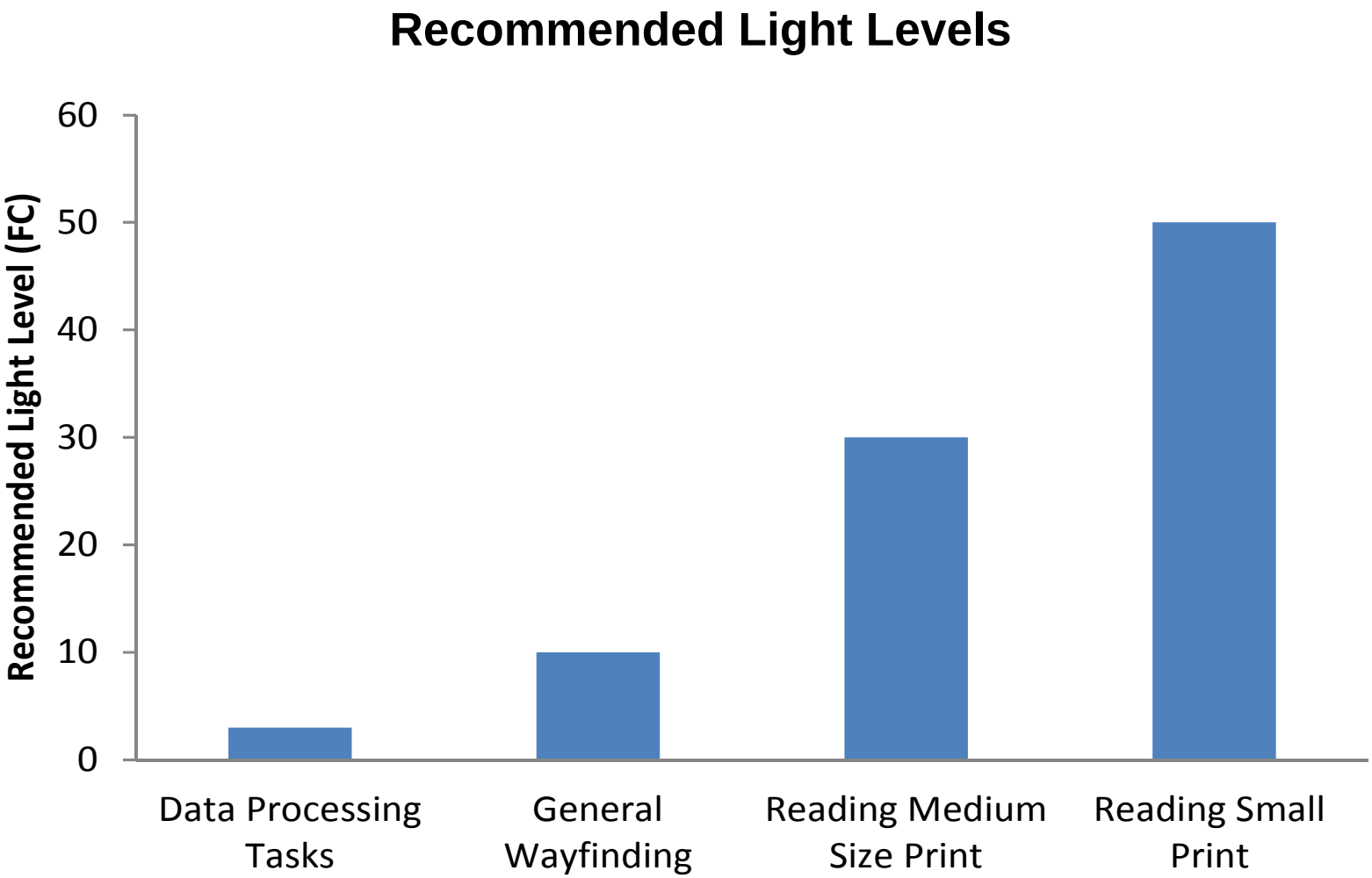
"Zero energy buildings that provide zero comfort or zero productivity increases to the occupants are of zero value"

Kevin Kampschroer

Director, Office of Federal High-Performance Green Buildings

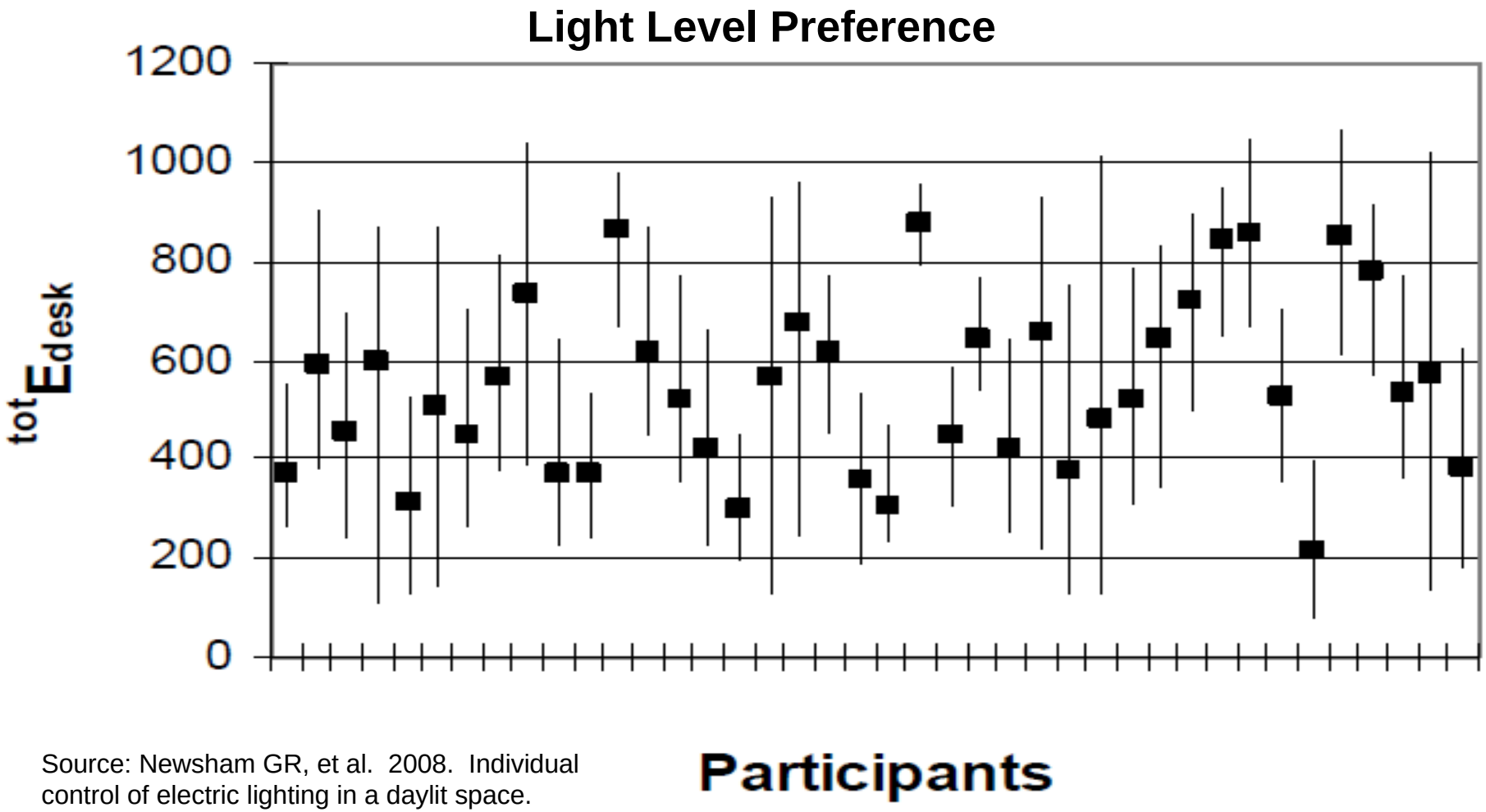
Source: Luncheon on Net Zero Energy Buildings at the House of Representatives in Washington D.C., June 18, 2010.

Value of Lighting Control



Source: The IESNA Lighting Handbook: 9th Edition.

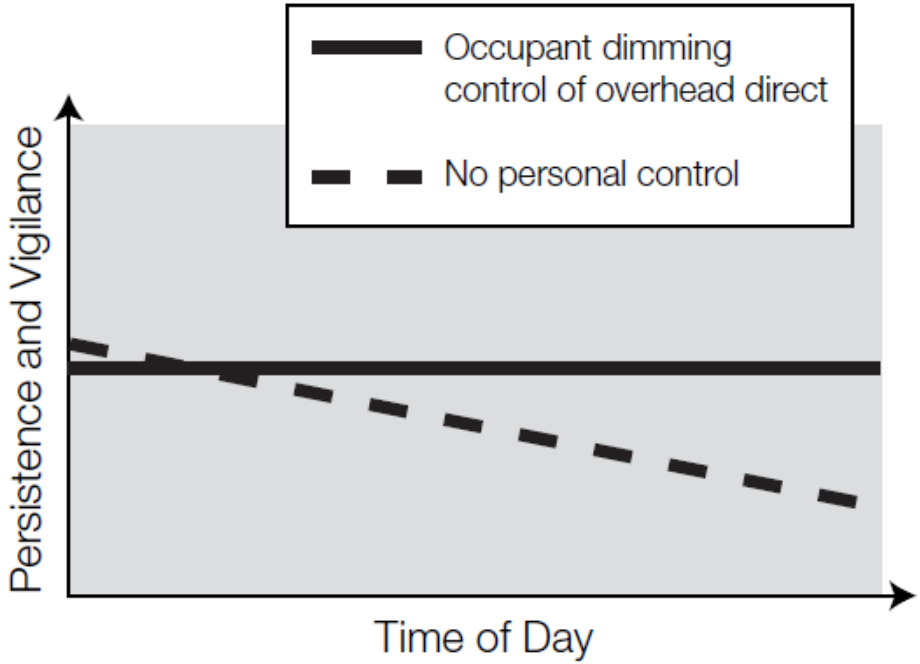
Value of Lighting Control



Source: Newsham GR, et al. 2008. Individual control of electric lighting in a daylit space. Lighting Research and Technology. 40(1) pg. 25-41.

Value of Lighting Control

Lighting Control and Productivity

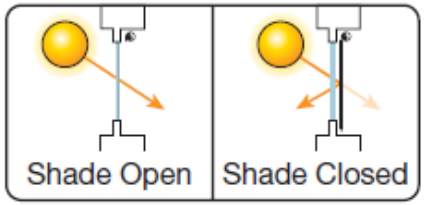


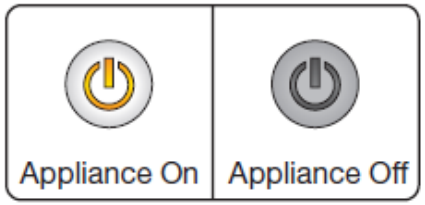
Note: Even a 1% Productivity increase provides $2 per ft² of annual savings[1]

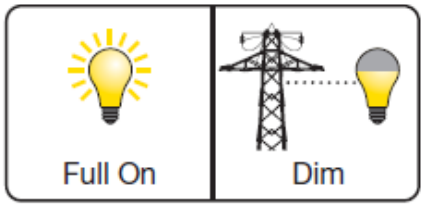
Sources: www.lightrightconsortium.org (Pacific Northwest National Laboratory)

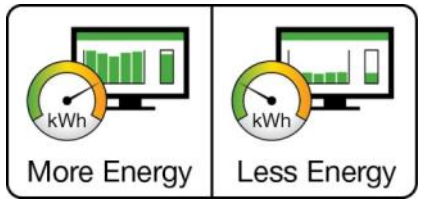
[1] Assumes $200/ft² annual salary without benefits.

Value of Integrated Lighting Control









Automated Shades: Automatically adjust shade position to maximize energy savings while reducing glare.
SAVE 10-20%[1] cooling

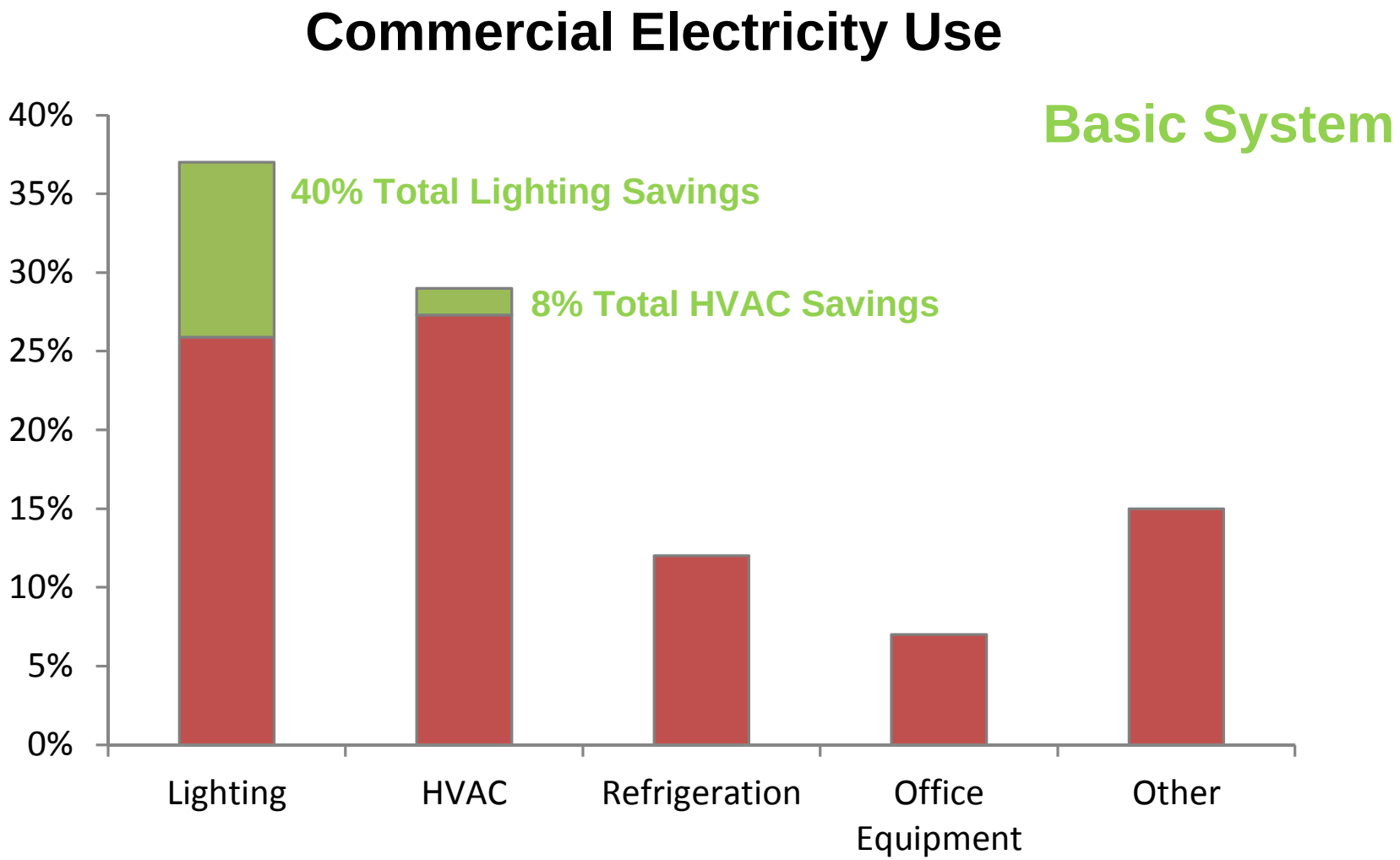
Plug Load Control: Automatically shut-off non-critical plug loads when the occupant leaves a room.
SAVE 15-50%[2] controlled load

Demand Response: Automatically dim electric lighting during demand events.
SAVE 20-50%[3] during peak period

Monitoring: Monitoring and reporting building energy usage and making adjustments as needed to maximize energy savings.
SAVE 5-15%[3]

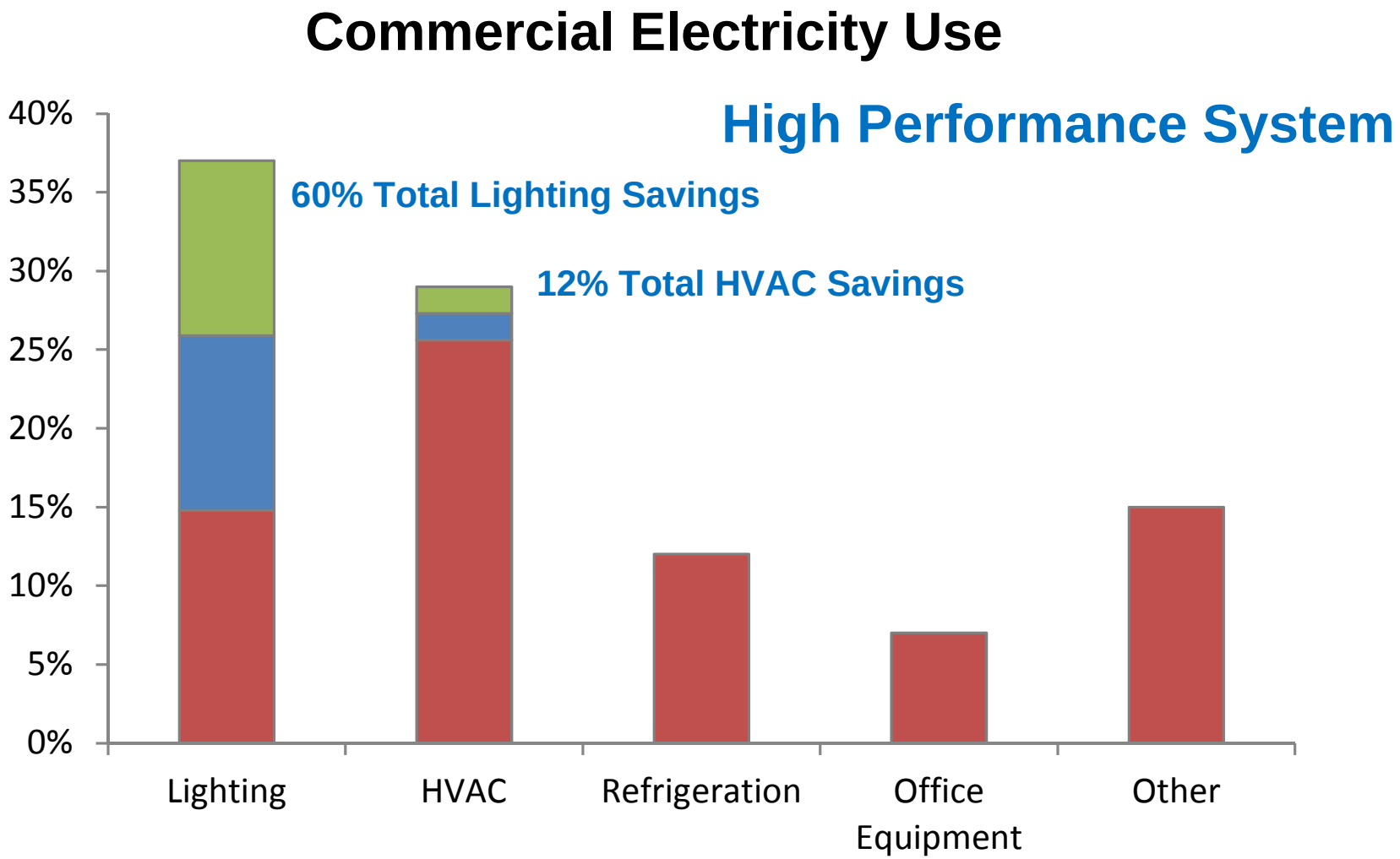
[1] Based on Lutron commissioned study by Herrick Laboratory, Purdue University.
[2] Source: Public Interest Energy Research (PIER) Program. 2011. Project report: commercial office plug load savings assessment.
[3] Source: Newsham GR & Birt B. 2010. Demand-responsive lighting: a field study. Leukos 6(3) pg. 203-225.
[4] Source: Darby S. 2006. The effectiveness of feedback on energy consumption. Environmental Change Institute.

Overall Value of Lighting Control



Source: http://www.eia.gov/emeu/cbecs/cbecs2003/lighting/lighting1.html

Value of Lighting Control



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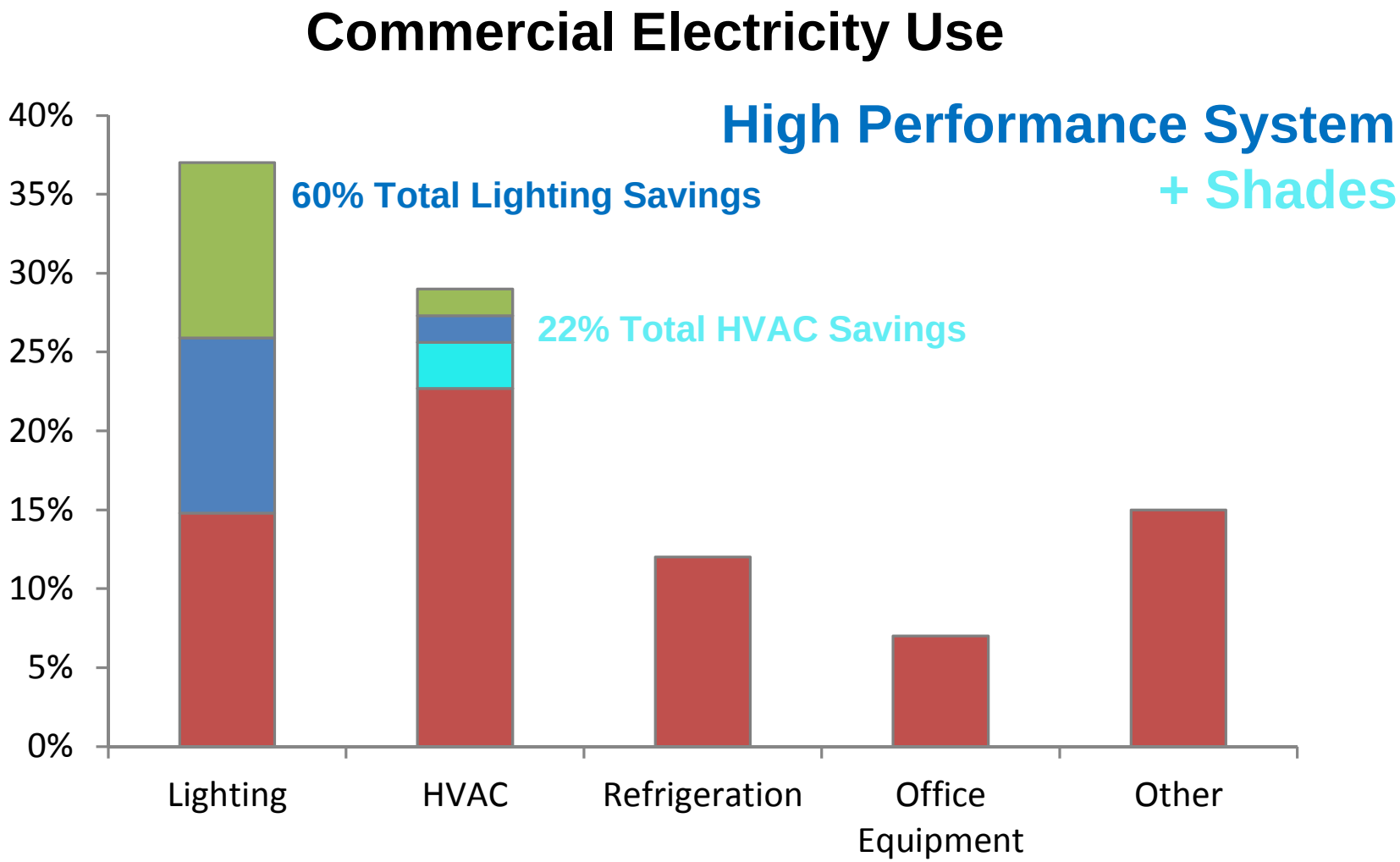
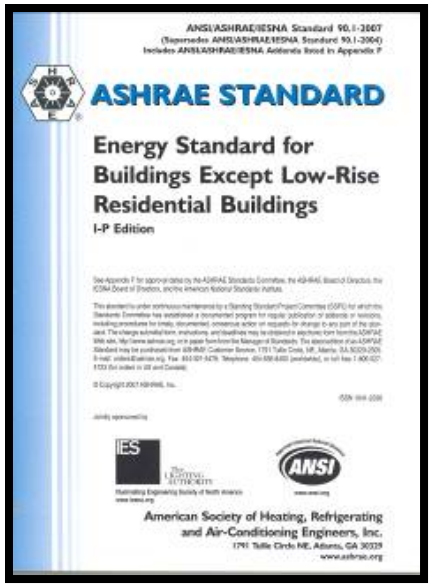
Value of Lighting Control

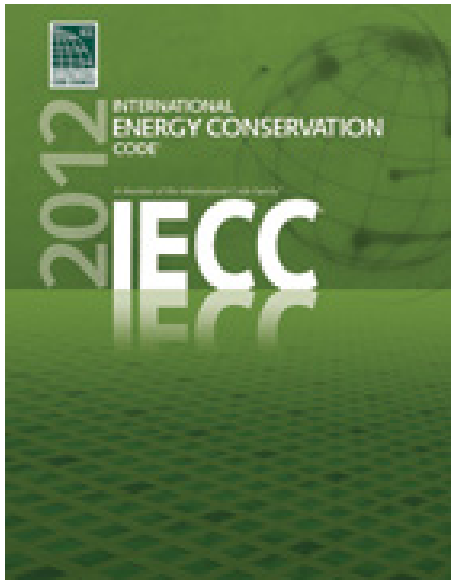


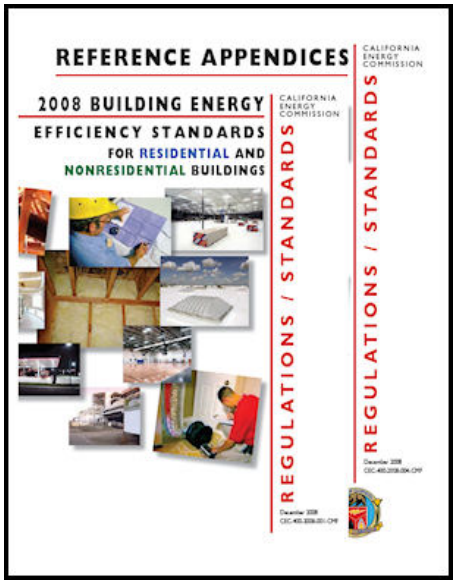
Source: http://www.eia.gov/emeu/cbecs/cbecs2003/lighting/lighting1.html

Energy codes -- the big 3

- ASHRAE 90.1
- IECC
- Title 24 (CA)
- They represent the minimum acceptable energy performance for a building



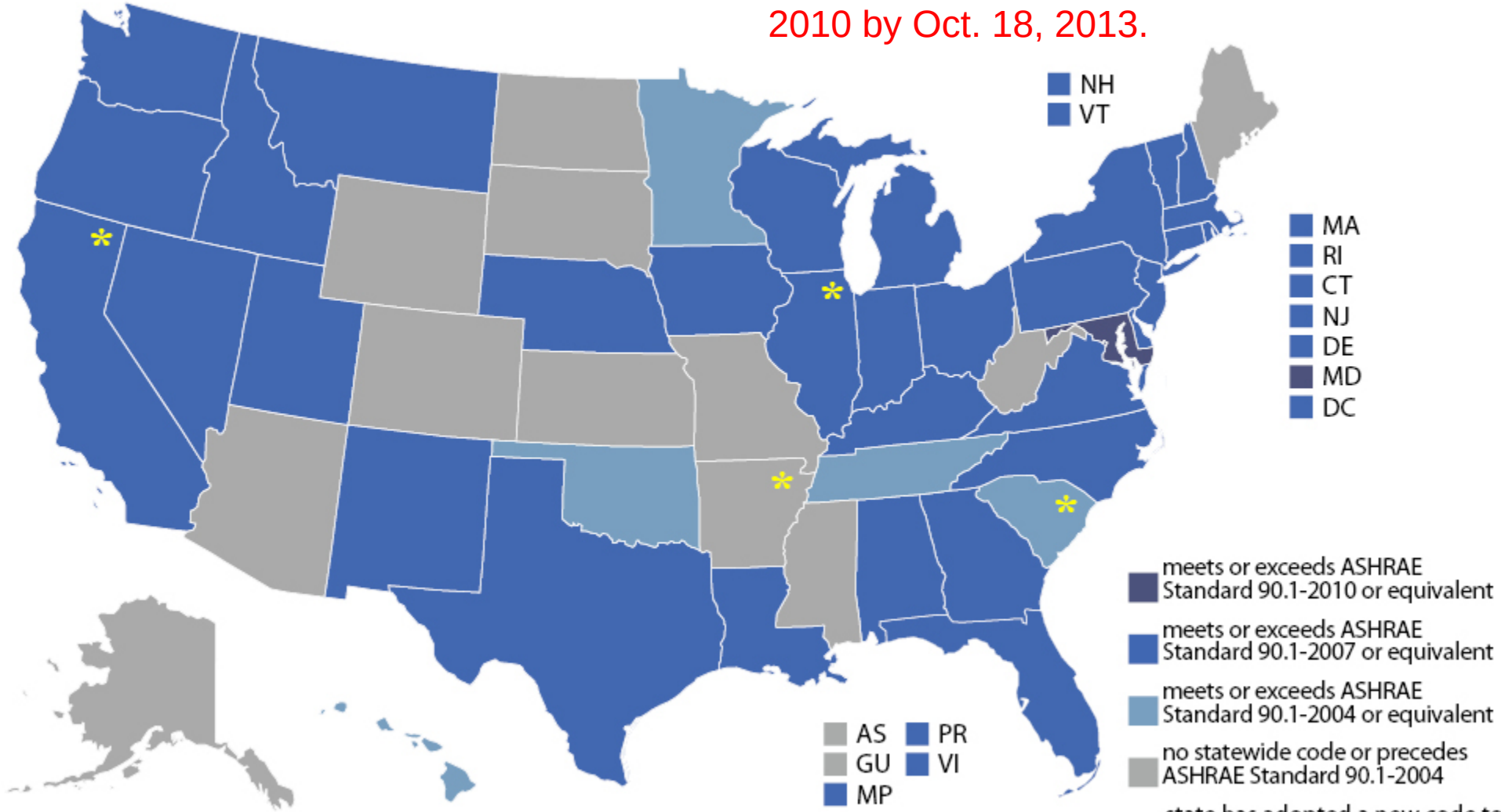




Commercial State Energy Code Status

AS OF OCTOBER 1, 2012

DOE Ruling Oct. 19, 2011: All states must adopt an energy code as stringent as 90.1-2010 by Oct. 18, 2013.



NOTE: These maps reflect only mandatory statewide codes currently in effect.

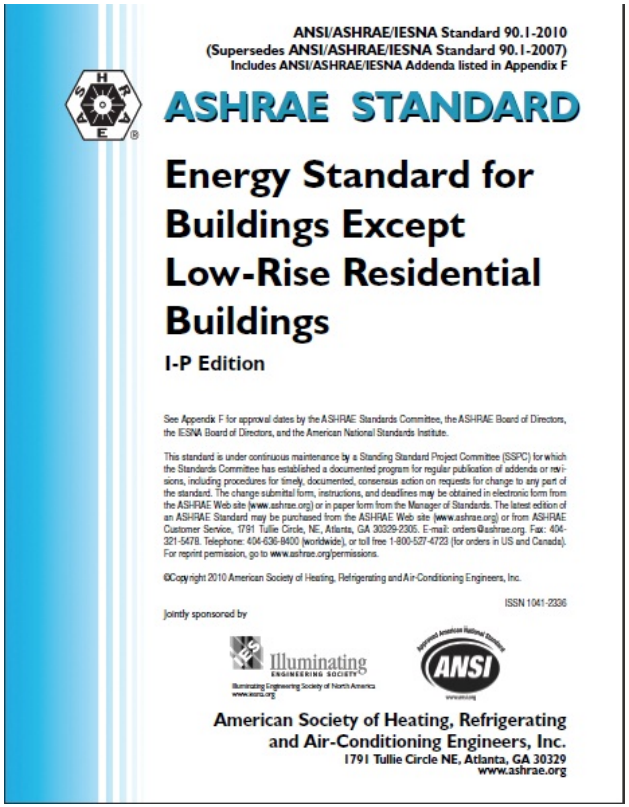
BCAP Dedicated to the adoption, implementation, and advancement of building energy codes

Get all the most up-to-date code status maps and other valuable resources at www.energycodesocean.org

Energy codes – ASHRAE 90.1

Standard 90.1 Basics

- Jointly sponsored by ASHRAE and IESNA
- 2010 is the current version
- Many state-specific codes and the IECC are based on 90.1.
- IECC references 90.1 as compliance option



ANSI/ASHRAE/IESNA Standard 90.1-2010
(Supersedes ANSI/ASHRAE/IESNA Standard 90.1-2007)
Includes ANSI/ASHRAE/IESNA Addenda listed in Appendix F

ASHRAE STANDARD

Energy Standard for Buildings Except Low-Rise Residential Buildings

I-P Edition

See Appendix F for approval dates by the ASHRAE Standards Committee, the ASHRAE Board of Directors, the IESNA Board of Directors, and the American National Standards Institute.

This standard is under continuous maintenance by a Standing Standard Project Committee (SSPC) for which the Standards Committee has established a documented program for regular publication of addenda or revisions, including procedures for timely, documented, consensus action on requests for change to any part of the standard. The change submittal form, instructions, and deadlines may be obtained in electronic form from the ASHRAE Web site (www.ashrae.org) or in paper form from the Manager of Standards. The latest edition of an ASHRAE Standard may be purchased from the ASHRAE Web site (www.ashrae.org) or from ASHRAE Customer Service, 1791 Tullie Circle, NE, Atlanta, GA 30329-2305. E-mail: orders@ashrae.org. Fax: 404-321-5478. Telephone: 404-636-8400 (worldwide), or toll free 1-800-527-4723 (for orders in US and Canada). For reprint permission, go to www.ashrae.org/permissions.

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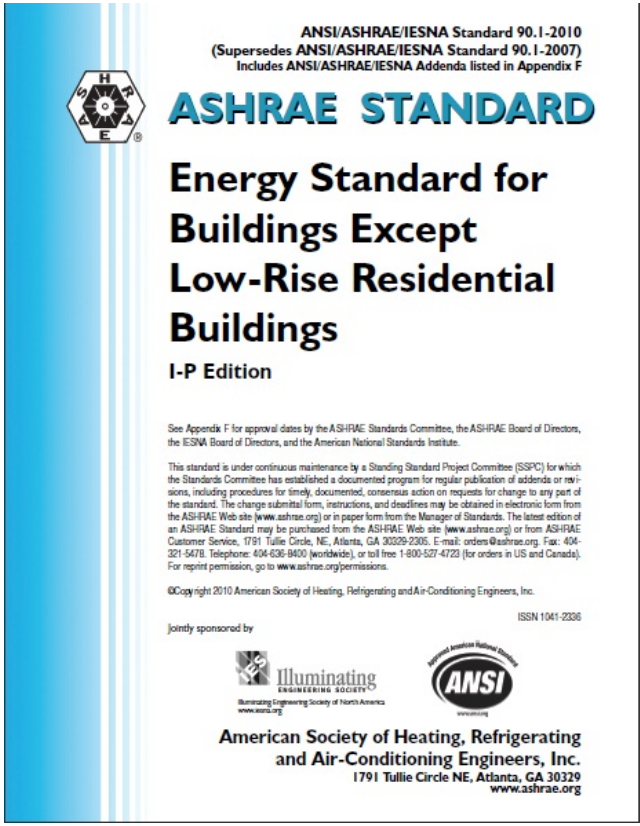
Energy codes – ASHRAE 90.1

Standard 90.1 Basics (cont.)

- New Construction and Additions
- All commercial type buildings including residential structures of 4 or more stories
- Interior and exterior lighting
- Lighting Alterations of more than 10% of the lighting load



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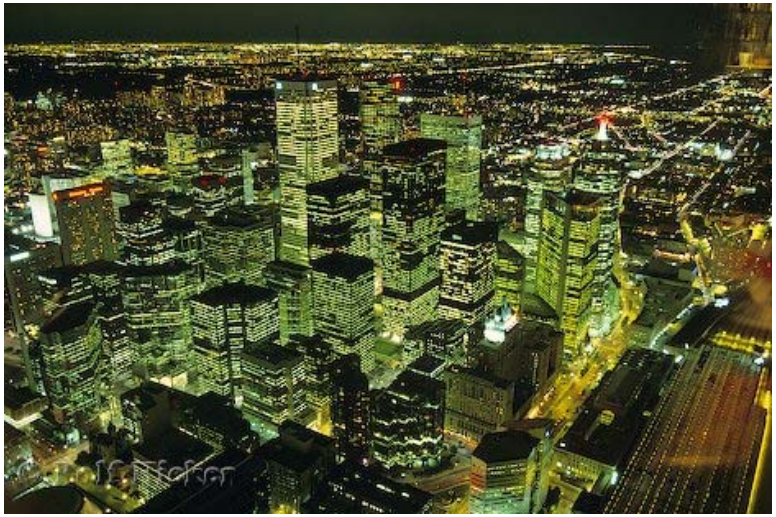
Automatic lighting shut-off (90.1 / IECC / T24)



Standard/Code:

90.1 2010, IECC 2012, T24 2008

Intent:

Eliminate after-hours lighting waste

Requirements:

- Automatic lighting shutoff control required in all interior spaces
- Override of automatic shutoff allowed for not more than 2 hours

Automatic lighting shut-off (90.1 / IECC / T24)

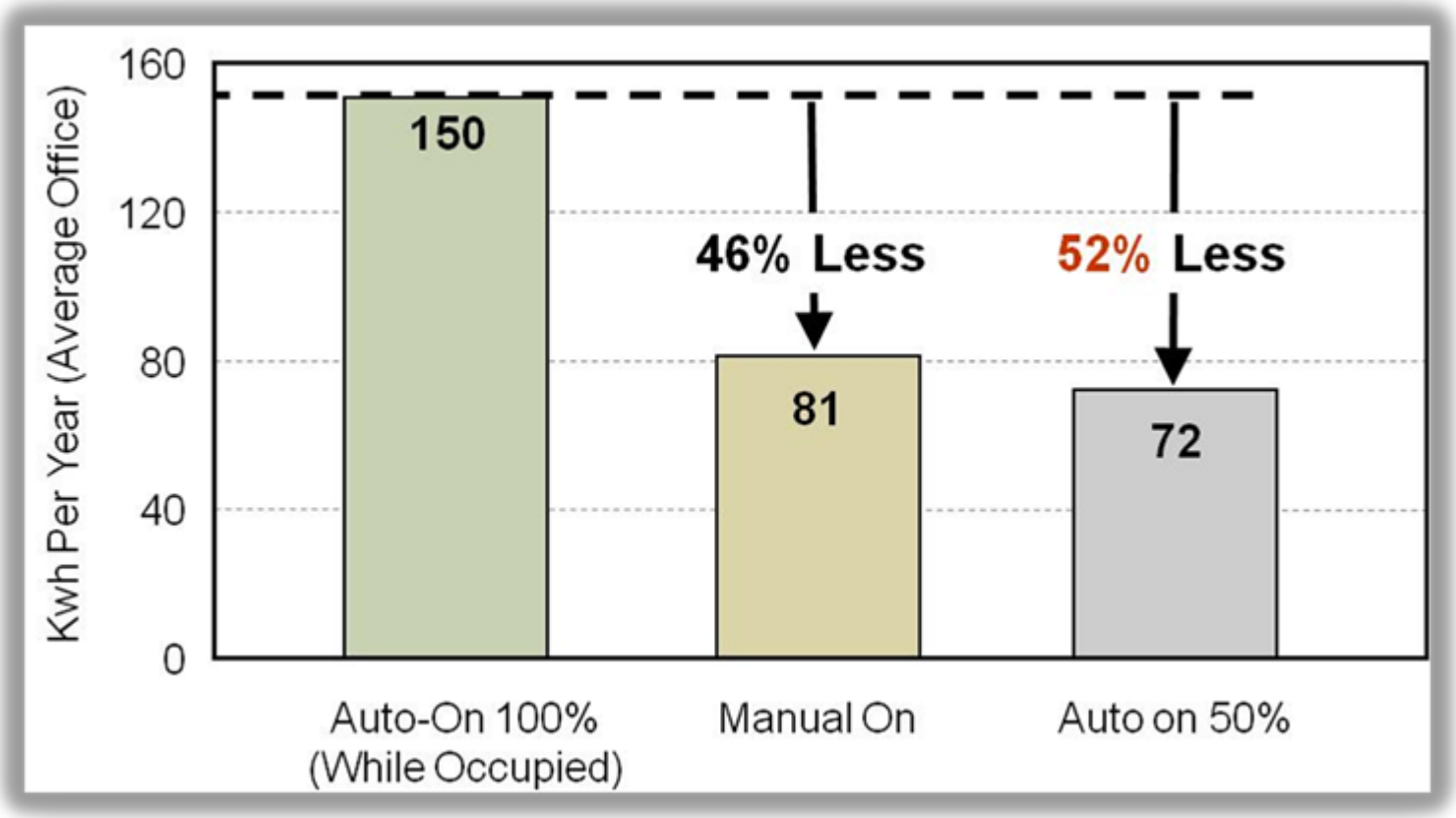
Light control solutions:

1. Control lights on a scheduled basis (automatic time switch)
2. Occupant sensor
3. Signal from another control or alarm that indicates the area is unoccupied

Note for 90.1 2010 and IECC 2012, occupancy sensors must be manual-on or auto-on to not more than 50% lighting power except in some spaces.

Manual-on vs. Auto-on

52% energy saving with Auto-On 50% control strategy over Auto-On 100%



http://www.aboutlightingcontrols.org/education/papers/2009/2009_bilevel_study.shtml

Space control (90.1 / IECC / T24)

Standard/Code: 90.1 2010, IECC 2012, T24 2008

Intent: Allow occupants to control unneeded lighting

Requirements:

- At least one lighting control for each room or space enclosed by ceiling-height partitions
- Readily accessible to occupants
- Remote location is allowed but must have indicator that identifies the lights served and their status (off or on)

Space control (90.1 / IECC / T24)

Light control solutions:

- Dimmers, switches, multi-scene controls, keypads, occupancy sensors
- Note that if using a timeclock for automatic lighting shut-off, the space controls must be connected to timeclock to allow for override of no more than 2 hours

Additional space control (90.1 / IECC)

Hotel/motel guest room lighting must be controlled at room entry

Additional space control (90.1 / IECC / T24)

Occupancy sensors, timer switch, or multi-scene controls are required in:

- Classrooms (except shop, lab, K-12)
- Conference/meeting rooms
- Employee lunch/break rooms
- Storage and supply rooms between 50 ft^2 and 1000 ft^2
- Rooms used for document copying and printing
- Office spaces up to 250 ft^2
- Restrooms
- Dressing, locker, and fitting rooms

Occupancy sensors must be manual-on or auto-on to not more than 50% lighting power except in some spaces.

Stairwell lighting (90.1)

Standard/code:

90.1 2010

Intent:

Eliminate wasted lighting in stairwells

Requirements:

Stairwell lighting shall be automatically reduced by at least 50% when vacant

Stairwell lighting (90.1)

<u>Light control solutions</u>:

- Occupancy sensor in conjunction with multi-level or dimmable lighting

Multi-level occ. sensor

Digitally addressable dimming ballast

Parking garage lighting control (90.1)

Standard/code:
90.1 2010

Intent:
Eliminate wasted lighting in parking garages.

Requirements:

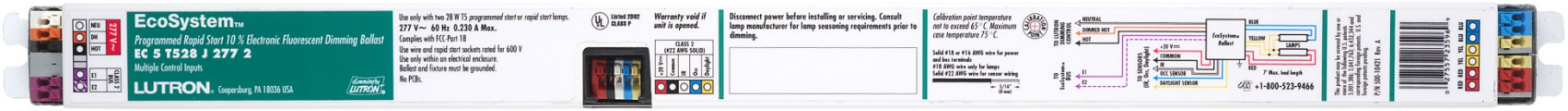
- Automatic lighting shut-off
- Automatic lighting reduction by a minimum of 30% when there is no activity detected.
- Daylight responsive lighting at entrances and wherever sufficient daylight exists

Parking garage lighting control (90.1)

<u>Light control solutions</u>:

- Occupancy sensors
- Daylight sensors
- Multi-level or dimmable lighting
- Astronomical time switch

Daylight sensor



Digitally addressable dimming ballast

Daylight zone control (90.1, IECC, T24)

Standard / Code: 90.1 2010, IECC 2012, T24 2008

Intent: Save lighting energy in daylighted spaces

Requirements:

- Daylight zones must be independently controlled
- Automatic multi-level daylight controls

Light control solution: Daylight sensors, dimming ballasts

Light reduction control (90.1 / IECC / T24)

Standard/code: 90.1 2010, IECC 2012, T24 2008

Intent: Allow occupants to moderate light levels to save energy.

Requirements:

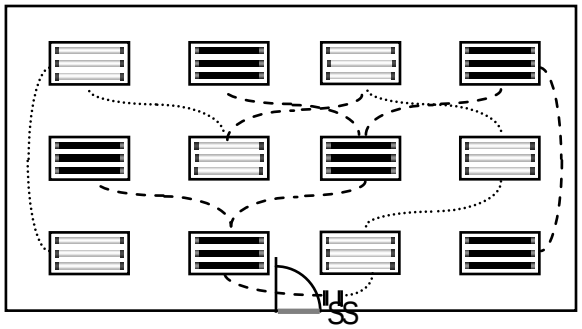
- Light Reduction Controls must allow the occupant to reduce connected lighting
  - By at least 50% (IECC)
  - Between 30% to 70% lighting power in addition to OFF (90.1 / T24)

Light reduction control (90.1, IECC, T24)

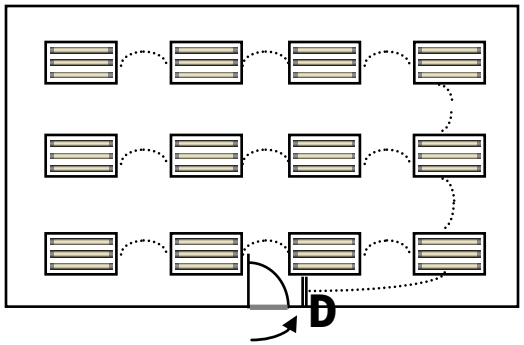
<u>Light control solutions</u>:

- 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)

Alternating Luminaires

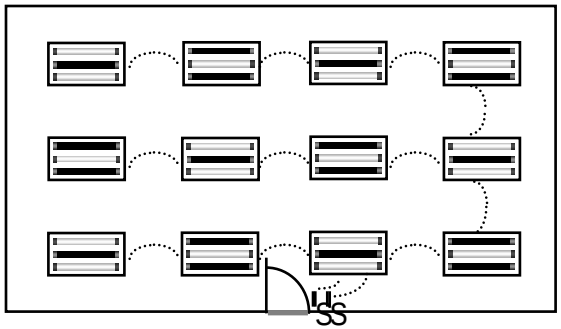


Dimming



Dimmer Switch

Alternating lamps



Exterior Lighting Control (IECC / T24 / 90.1)

Standard/code: IECC 2012, T24 2008, 90.1-2010

Intent: Eliminate wasted exterior lighting

Requirements:

- Automatically turn outdoor lighting off when daylight is available.
- All façade and landscape lighting shall be automatically shut off from midnight to 6 am. (90.1)
- All other lighting shall be controlled by a device that automatically reduces the connected lighting power by at least 30% (90.1)

Light control solution:

- Astronomical timeclocks, time switches, daylight sensors

Functional testing (90.1, IECC , T24)

Standard/code: 90.1-2010, IECC 2012, Title 24 2008

Intent: To ensure that controls are calibrated, adjusted, programmed, and in proper working condition

Requirements:

- Confirm that the following devices have been functionally tested:
  - Occupancy Sensors
  - Photosensors
  - Time Switches (Timeclock)

Note: The party responsible for functional testing cannot be part of the design or construction team. The light control manufacturer can do the functional testing.

Automatic receptacle control

Standard/code: 90.1 2010

Intent: Eliminate unnecessary plug loads from task lighting and other devices.

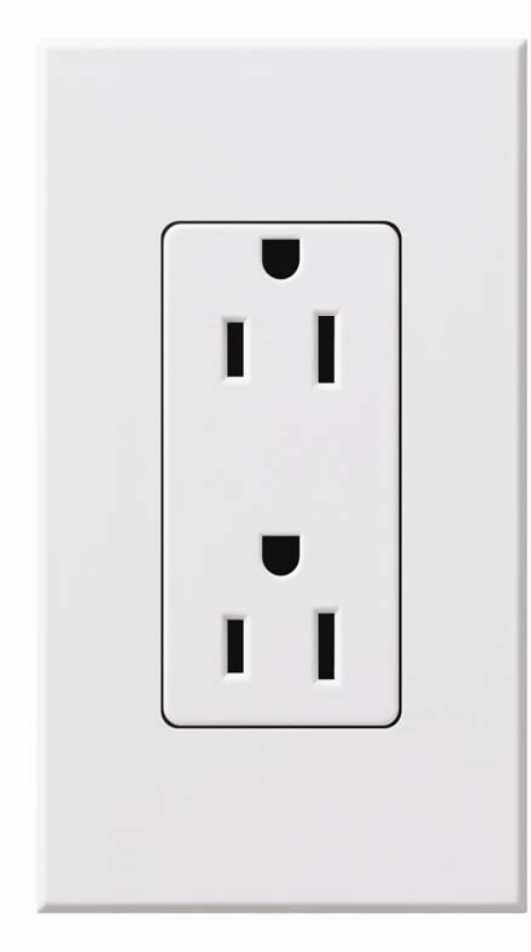
Requirements:

- At least 50% receptacles installed in private offices, open offices, and computer classrooms shall be controlled by an *automatic control device*

Light Control Solution:

- Receptacles controlled by timeclocks or occupancy sensors.

Note the automatic control devices cannot be plugged into the receptacle (i.e. a power strip that talks to an occ sensor and is plugged into a receptacle doesn't comply)



Lighting control incentives (90.1 / T24)

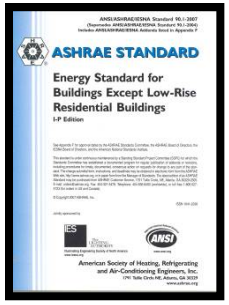
Watts per square foot incentives for using additional lighting controls above mandated requirements. (Table below is from Title 24 2008, ASHRAE 90.1 2010 has a similar table).

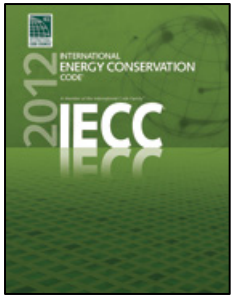
What	Where	PAF
Multi-level occupant sensor	Any space <250 sf, any size classroom, conference room, corridor	0.20 (0.25 w/ dimming), or +0.10 on top of daylighting
Demand response	All spaces	0.05
Manual dimming	All spaces	0.10
Automatic photocontrols	Primary and secondary daylit areas <2,500 sf	0.12-0.30

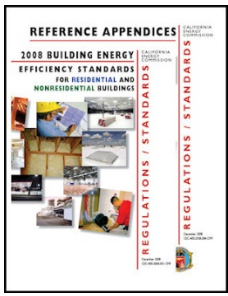
Summary of lighting control requirements

Key mandatory lighting control requirements (summary of the big 3 standards/codes): 90.1 2010, IECC 2012, T24 2008

- Automatic shut-off (occ sensors, timeclocks)
- Space Control (dimmers, switches connected to timeclocks, occ sensors)
- Stairwell lighting control (occ sensors, dimming ballasts)
- Parking garage lighting control (occ sensors, daylight sensors, timeclocks, dimming ballasts)
- Daylight zone control (daylight sensors)
- Light reduction controls (dimmers, pre-set scene controls, bi-level switching)
- Exterior lighting control (daylight sensors, timeclocks)
- Functional testing of controls
- Receptacle control
- Watts per ft^2 incentives for additional controls

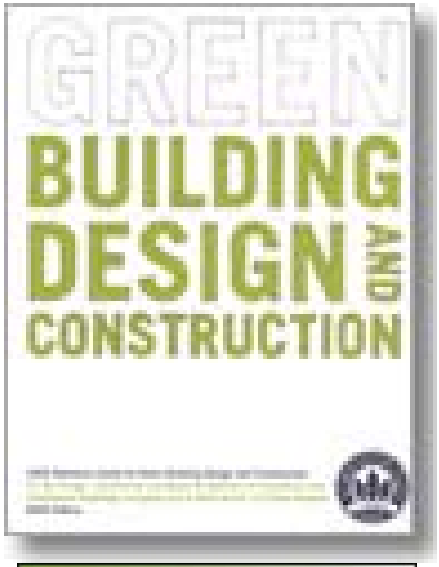






Other standards/codes

- LEED 2009
  - Light control can contribute to 40 or more out of the 110 possible points in LEED NC 2009
- ASHRAE 189.1 High Performance Green Buildings
  - Up to 10% reduction in LPD's from 90.1-2010
  - Peak load reduction (i.e. demand response)
  - Projections or automated shading
  - Energy monitoring
- IgCC (ICC green code, similar to 189).
  - 2012 version just released
  - Automatic receptacle control
  - Energy monitoring
- ASHRAE 100 (existing building standard, coming in 2012)



Coming soon

- Energy monitoring in energy codes
- More automatic receptacle control
- Emergency lighting control
- Lighting quality in green codes
- Demand responsive lighting/dimming (T24 2013)
- NYC Local Law 88 (“Lighting Upgrade Law”)
- Space-by-space control requirement table (90.1-2013)

90.1-2013 Space-by-Space Control Requirements (Public Review Addendum BY)

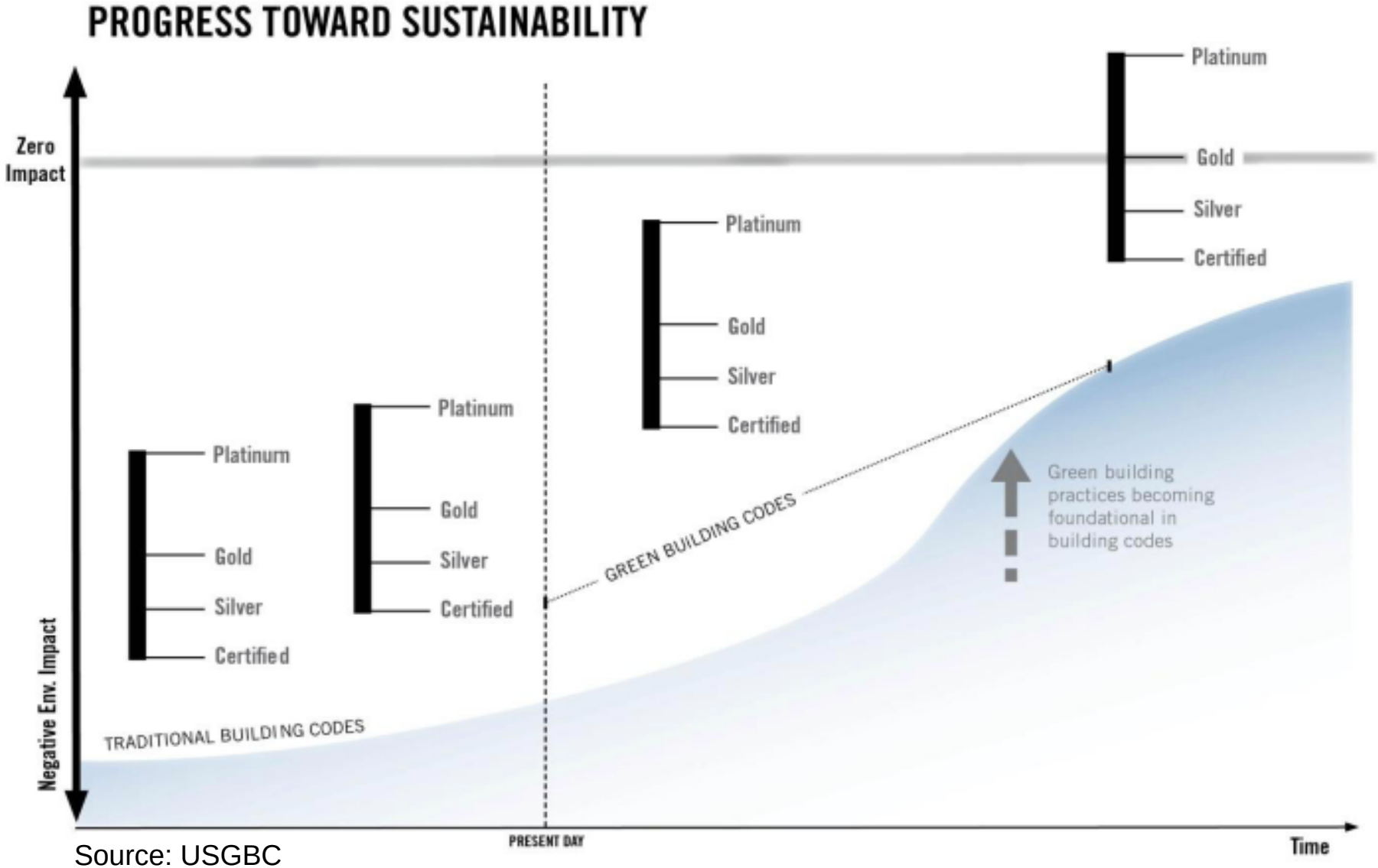
TABLE 9.6.1 - Lighting Power Density Allowances Using the Space-by-Space Method and Minimum Control Requirements Using Either Method

The control functions below shall be implemented in accordance with the descriptions found in the referenced paragraphs within Section 9.4.1.1. For each Space Type:

(1) All REQ's shall be implemented.
(2) At least one ADD1 (when present) shall be implemented.
(3) At least one ADD2 (when present) shall be implemented.

Common Space Types[1]	LPD (watts/ sq.ft)	RCR Thres hold	Local Control see 9.4.1.1 (a)	Restricted to Manual ON see 9.4.1.1 (b)	Restricted to Partial Automatic ON see 9.4.1.1 (c)	Bi-level Lighting Control see 9.4.1.1 (d)	Automatic Daylight Responsive Controls for Sidelighting see 9.4.1.1 (e)6	Automatic Daylight Responsive Controls for Toplighting see 9.4.1.1 (f)6	Automatic Partial OFF see 9.4.1.1 (g) (Full Off complies)	Automatic Full OFF see 9.4.1.1 (h)	Scheduled Shutoff see 9.4.1.1 (i)
			a	b	c	d	e	f	g	h	i
Office											
... enclosed and <= 250 sq.ft	1.11	8	REQ	ADD1	ADD1	REQ	REQ	REQ		REQ	
... enclosed and > 250 sq.ft	1.11	8	REQ	ADD1	ADD1	REQ	REQ	REQ		ADD2	ADD2
... open plan	0.98	4	REQ	ADD1	ADD1	REQ	REQ	REQ		ADD2	ADD2

Energy codes, green codes, and LEED

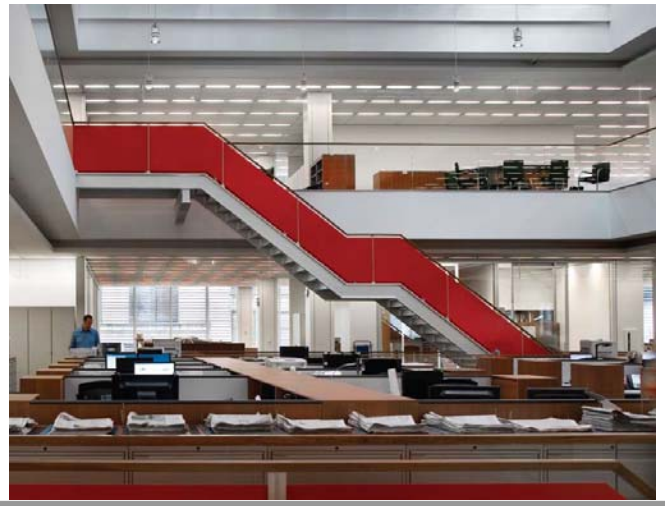


Source: USGBC

Case Study – The New York Times Building

"We designed our building to use 1.28 watts per square foot of lighting power. …it's only using 0.396 – that's about 70% less."

Glenn Hughes,
Director of Construction for The New York Times Company during design, installation, and commissioning of The New York Times Building



Case Study – The New York Times Building

The New York Times

New York, New York, USA

Strategy:

- Light level tuning
- Daylight harvesting
- Occupancy sensing

Estimated annual savings:

- 70% lighting energy
- $600,000
- 3,200 metric tons of CO_2

Case Study – The New York Times Building

Light control solutions

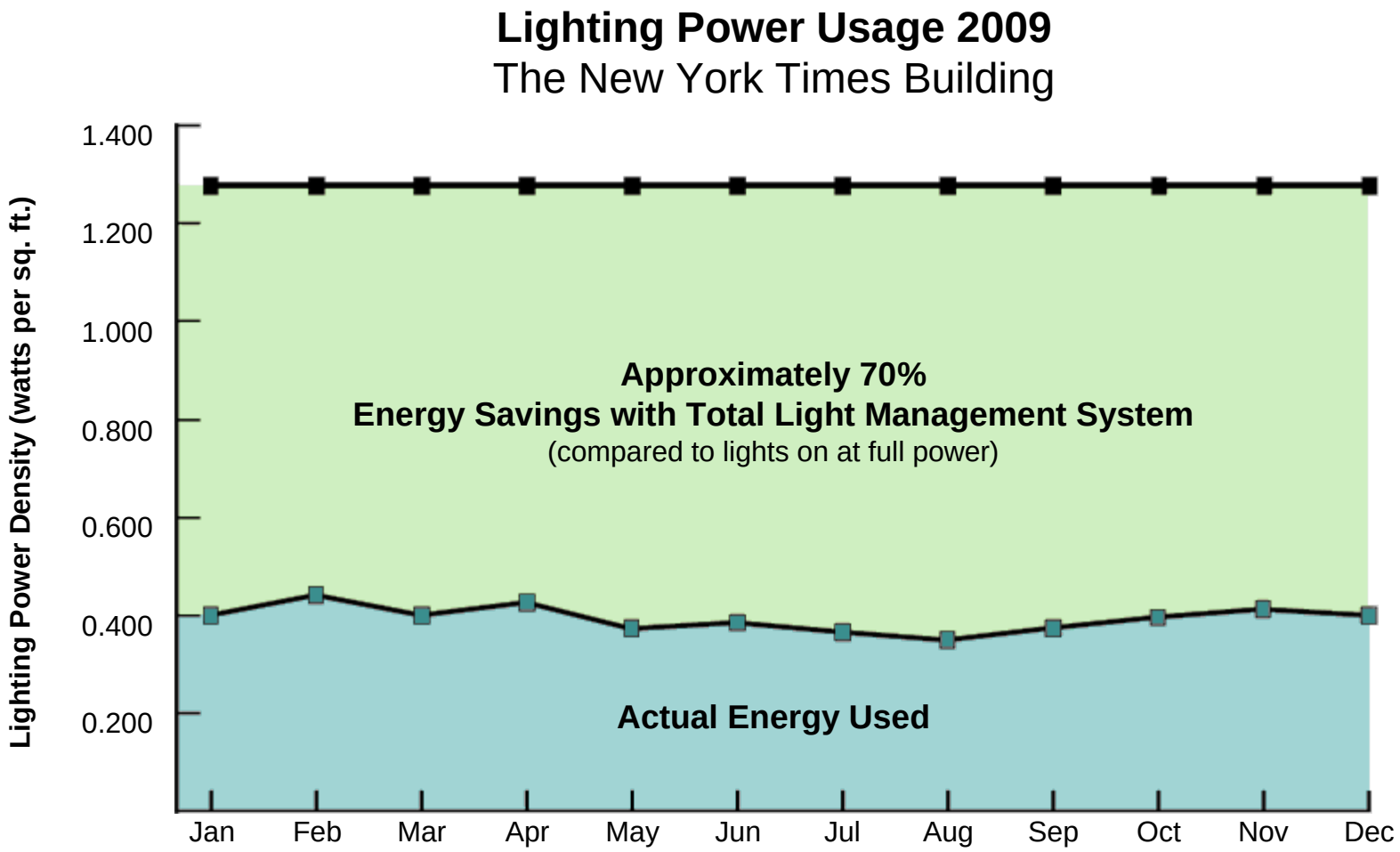
- Total light management system
  - Digital dimming ballasts
  - Daylight sensors
  - Occupancy sensors
  - Light management software

Lights Off

Lights Dimmed by 80%

Lights Dimmed by 50%

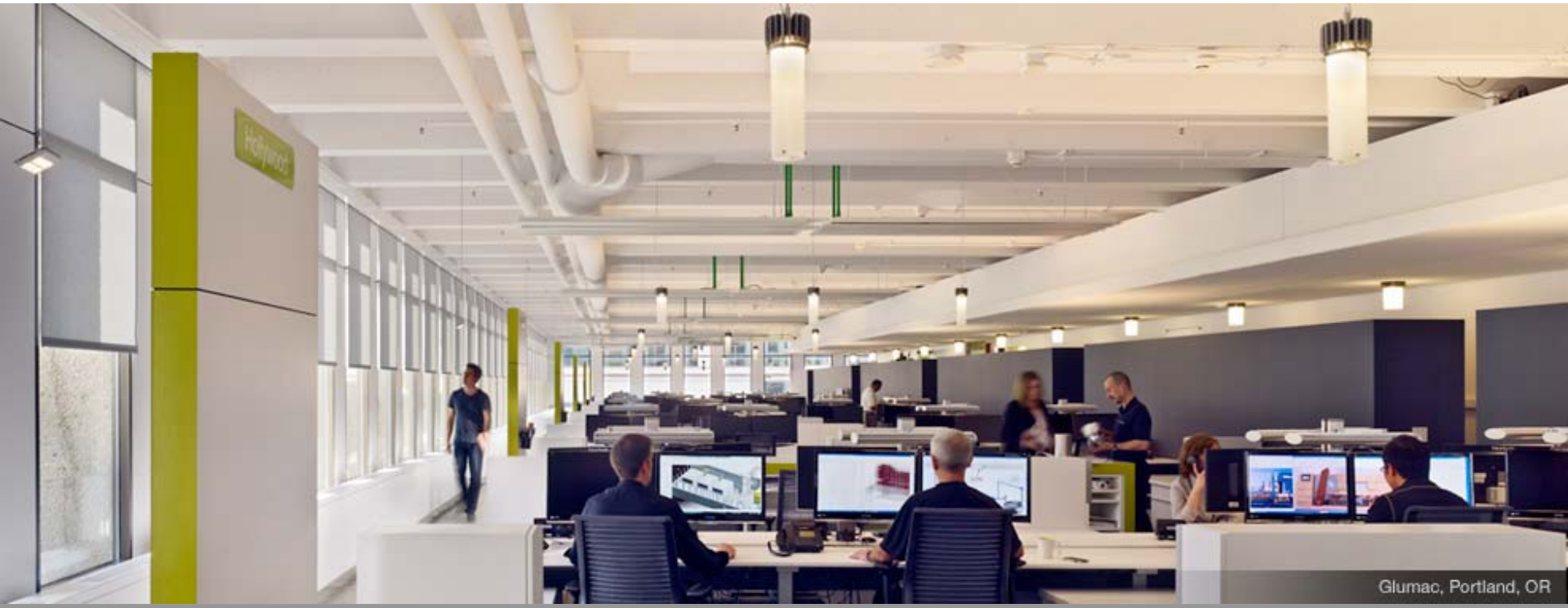
Case Study – The New York Times Building



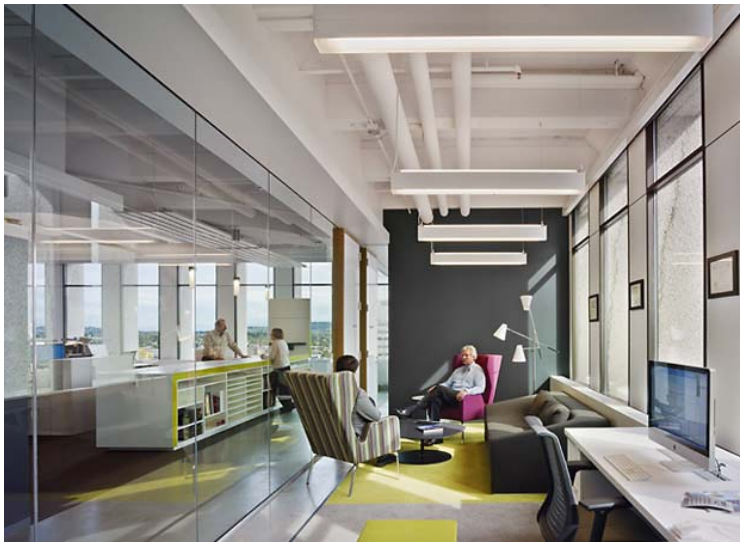
Case Study – Glumac

"In spaces with abundant daylight, people, not sensors, should turn ON the lights. The best sensor ever developed is the human eye."

Kirk Davis, Managing Principal
Glumac Portland



Case Study – Glumac



Glumac

Portland, OR, USA

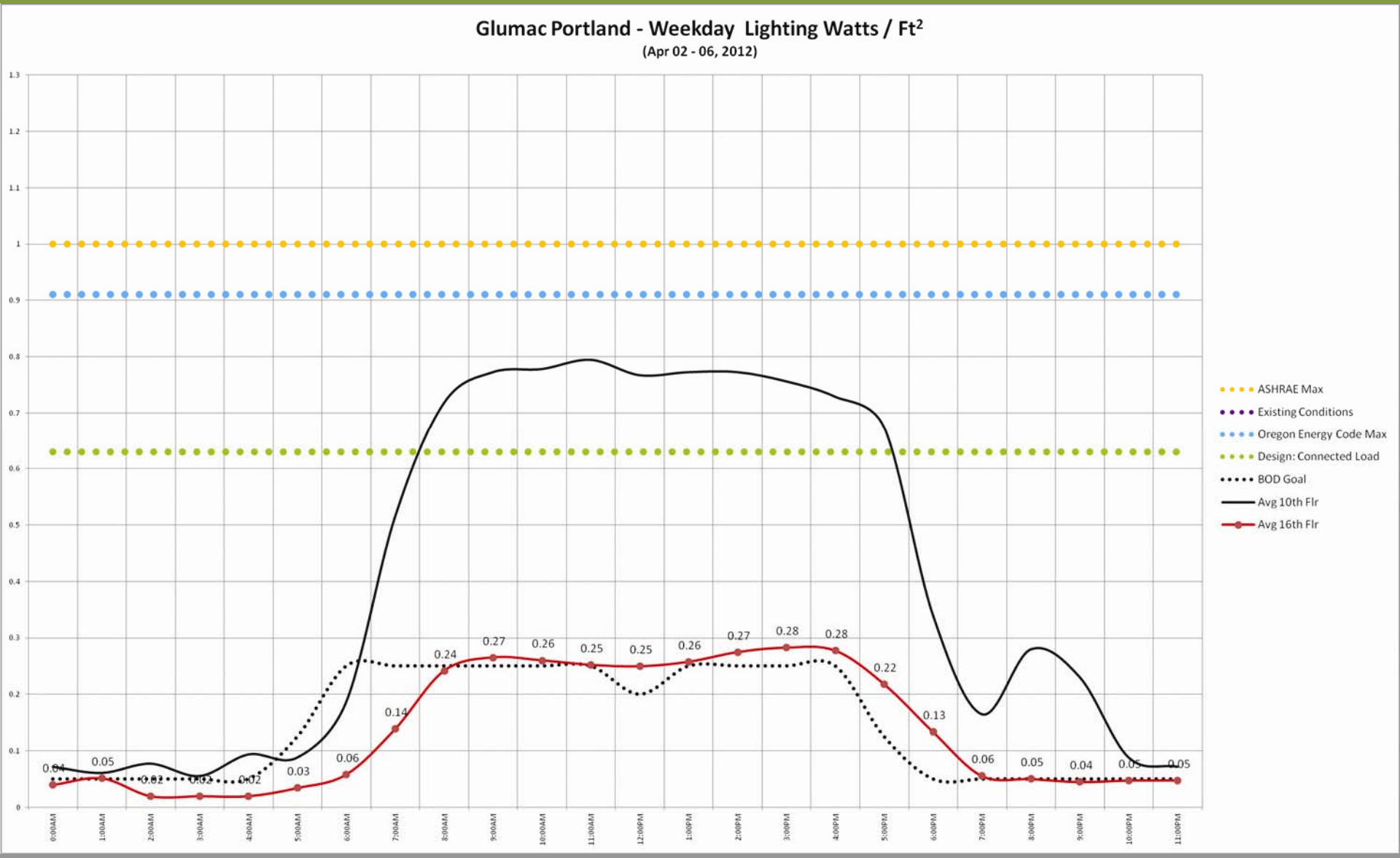
Strategy:

- Wireless vacancy sensors
- Wireless daylight sensors
- Digitally addressable dimming ballasts
- Solar-adaptive shading

Estimated savings:

- Over 70% lighting energy

Case Study – Glumac



More information on energy codes

Energy codes:

- www.ashrae.org
- www.iccsafe.org

State code information:

- www.energycodes.gov
- www.energycodesocean.org

ASHRAE interpretation requests:

- http://www.ashrae.org/standards-research--technology/standards-forms--procedures/how-to-request-an-interpretation

ASHRAE public review comments:

- http://www.ashrae.org/standards-research--technology/public-review-drafts

IECC interpretations:

- ICC Members can call 888-422-7233, ask for Technical Opinions

Questions?