



**CALIFORNIA
ENERGY**
CODES & STANDARDS

A STATEWIDE UTILITY PROGRAM

Second Stakeholder Meeting for **Outdoor Lighting Controls**

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1. Background



Introduction to Outdoor Lighting Controls

- Outdoor lighting can be controlled in three general ways:
 - Automatic scheduling control: Time-based lighting control device or system that is capable of being programmed to reduce or turn OFF outdoor luminaire power for a portion of the night and the day.
 - Photocontrol & Astronomical Time-switch: Automatically turns lights ON and OFF, or automatically adjusts lighting levels, in response to daylight.
 - Occupant sensing control: Automatically turns lights OFF after an area is vacated of occupants, and automatically turns the lights ON when the area is occupied.



Photocell
Sensor

Introduction to Outdoor Lighting Controls

- Occupancy based controls are used to moderate light output and can be integrated into the luminaire or mounted remotely.
 - Sensor integrated fixtures that are individually controlled are becoming common and widely available.
 - Remotely mounted sensors can potentially control multiple luminaires and can save on material and labor costs.



Occupancy Sensor



Relevant Code History

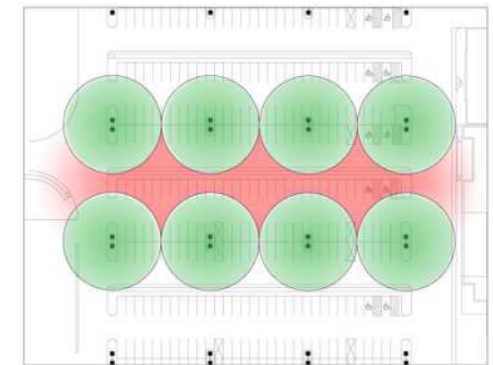
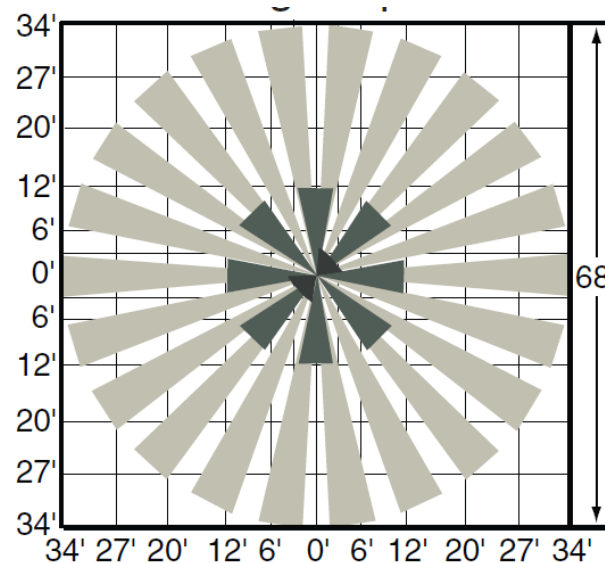
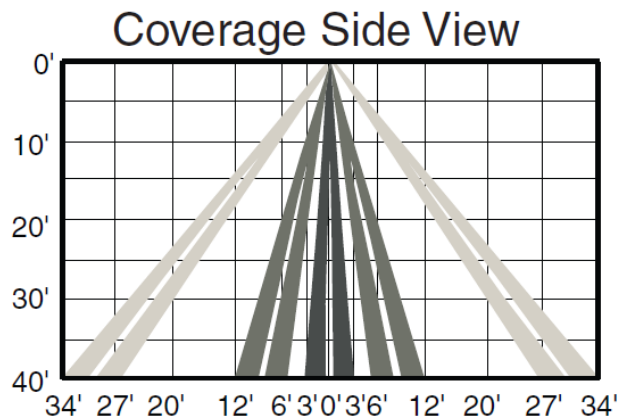
- Section 130.2(c) says outdoor lighting shall be:
 - Controlled by **photocell or outdoor astronomical time-switch** that turns the lights OFF in daylight
 - Controlled independently from other electrical loads by **automatic scheduling control**
 - All installed outdoor lighting **mounted \leq 24 feet** above the ground shall be controlled with motion sensors and be capable of reducing lighting 40 – 90%
 - Employ auto-ON when occupied
 - **No more than 1,500 Watts** of lighting power shall be controlled together

Relevant Code History

- There is an Exception to 130.2(c)3:
 - Pole-mounted luminaires below 75W are exempted
 - Non-pole-mounted luminaires below 30W are exempted
- Other Code Requirements relevant to this exception:
 - ASHRAE 90.1
 - 78W threshold
 - ASHRAE 189.1
 - 50W threshold

Relevant Code Proposal History

- Technical Barrier: Poles taller than 24 feet
 - Needs additional research; pursuing for 2022



Relevant Code Proposal History

- Technical Barrier: Poles taller than 24 feet
 - Fog, snow, and ice may limit the detection distance, which is exacerbated by higher mounting heights



2. Proposed Code Changes

Proposed Code Change

- Proposed code changes include:
 - Revision to EXCEPTION 3 to Section 130.2(c)3
 - Revision to Section 130.2(c)3
 - Code language simplifications
- Mandatory requirements apply to nonresidential, high-rise residential and hotel/motel buildings

Proposed Code Change

- Revision to EXCEPTION 3 to Section 130.2(c)3:
 - Outdoor lighting where luminaire rated wattage is 30 Watts or less is exempted from 130.2(c)3 control requirements
 - Previously 75 Watts for pole-mounted and 30 Watts for non-pole-mounted luminaires

<75W

Current Exemption



<30W

Proposed Exemption

Proposed Code Change

Current code

- All outdoor lighting must have:
 1. Photocell, astronomical time-switch, or other control that turns lights off during the day.
 2. Independent automatic scheduling control
 3. Luminaires higher than 24ft must have:
 - A. Motion controls or other controls that respond to vacancy
 - B. Capability to reduce lighting power 40 – 90% when vacant
 - C. Auto-ON when occupied
 - D. No more than 1,500 Watts controlled together
- Except:
 - Wattage exemptions
 - Outdoor Sales Frontage, Building Façade, Ornamental Hardscape, Outdoor Dining

Proposed Code Change – Option 1

Proposed revision to Section 130.2(c)3:

- During normally scheduled operating hours:
 - When vacant, controls shall automatically reduce the lighting power of each luminaire by at least 50% but not exceeding 90%; and
 - When occupied, controls shall turn lights ON or increase power to at least 80% of full power; and
- During after-hours schedule:
 - When vacant, controls shall reduce lighting power by at least 80% or turn lights completely OFF

Proposed Code Change – Option 2: Tri-Level Controls

Proposed revision to Section 130.2(c)3:

- During normally scheduled operating hours:
 - When vacant, controls shall automatically reduce the lighting power of each luminaire by at least 50% but not exceeding 90%; and
 - When occupied, controls shall turn lights ON or increase power to at least 80% of full power.
- During after-hours schedule:
 - When vacant, controls shall reduce lighting power by at least 80% or turn lights completely OFF; and
 - When occupied, controls shall be capable of turning lights ON or increasing power to at least 50% of full power.

Proposed Code Change

Section 130.2(c)3 Controls State Diagram – Option 1

Automatic Scheduling Control	Motion Controls	
	Occupied	Vacant
Normally scheduled operating hours	Full ON	Dimmed by 50% - 90%
After-hours schedule	No requirement	Dimmed by at least 80%, (or full OFF)

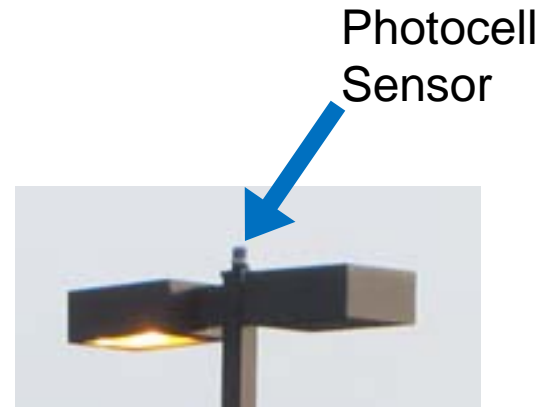
Proposed Code Change

Section 130.2(c)3 Controls State Diagram – Option 2: Tri-Level Controls

Automatic Scheduling Control	Motion Controls	
	Occupied	Vacant
Normally scheduled operating hours	Full ON	Dimmed by 50% - 90%
After-hours schedule	Dimmed by 0% - 50%, (or full ON)	Dimmed by at least 80%, (or full OFF)

Proposed Code Change

- Code simplification, considering:
 - Striking the option for outdoor astronomical time-switch in favor of only using photocell control in 130.2(c)1



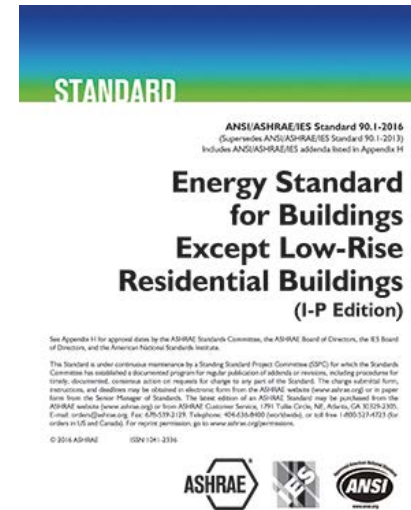
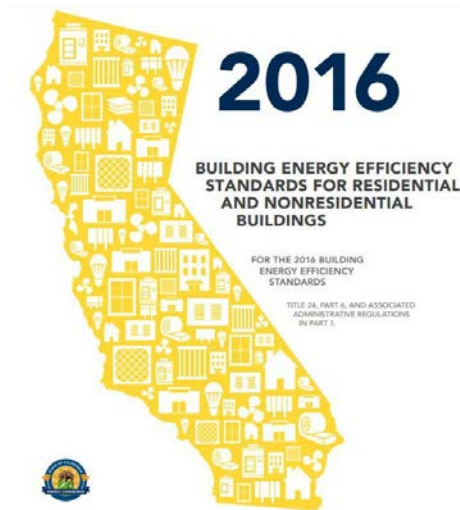
Discussion



- Do you understand the proposed revision to Section 130.2(c)3?
- Do you understand the proposed addition of tri-level controls?
- Do you understand the proposed code change simplifications?

Why Are We Proposing These Code Changes?

- ✓ Save energy
- ✓ Align with ASHRAE 90.1-2016
- ✓ Reduce code complexity



3. Technical and Market Barriers

Discussion



- Are you aware of additional technical / market barriers that we haven't identified?

4. Compliance and Enforcement

Compliance Process



Design Phase

- Designers identify whether outdoor lighting controls will be required:
 - Exterior fixtures greater than 30 Watts

Compliance Process



Permit Application Phase

No significant changes to this phase.

- Plans examiner reviews all applicable compliance worksheets and compares to construction documents to verify system design specifications are consistent.
- Plans examiner may provide correction comments to the designer to resolve any issues.

Compliance Process



Construction Phase

- No significant changes to this phase.
 - Exterior space is constructed per design specifications.
 - Lighting installer completes Certificate of Installations.
 - Certificate of Installations are required to be submitted or posted at the building site prior to functional testing and completion of the Certificate of Acceptance.

Compliance Process



Inspection Phase

- Building inspector reviews Certificates of Installation in the field and issues certificate of occupancy.
- Building inspectors can use notes from plans examiners to identify top field verification priorities.
- Acceptance testing to be completed:
 - Outdoor lighting: CEC-NRCA-LTO-02-A

Discussion



- Are you aware of additional compliance or enforcement barriers that we haven't identified?

5. Cost-Effectiveness and Energy Impacts

Published Data



- Western Exterior Occupancy Survey
 - Tracked occupancy at 8 different building types
 - Found that night occupancy ranges from 12% to 98%, depending on space type and hours of operation

- West Sacramento, Raley's
 - BetaLED fixtures with integrated sensors installed at Raley's Market
 - Found nighttime occupancy rate of 55%
 - http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/gateway_raleys.pdf



Published Data



- SCE Design & Engineering Services: Occupancy Sensors in Exterior Lots
 - Installed LEDs in exterior open lot with bi-level controls, 100% high and 17% low mode after 6 minute delay
 - Found savings from occupancy sensors to be 17.3%

- ETAP: Contra Costa County
 - Installed Bi-level LEDs at the Pittsburg Health Center
 - Found nighttime occupancy rate of 12%



Definition of Baseline and Proposed Conditions

- **Baseline Conditions**

- Pole-mounted luminaires less than 75 watts are controlled by photocell
- Operating hours: 4,745

- **Proposed Conditions**

- Occupancy-based controls:
 - High output power: 100%
 - Low output power: 50%
- Average nighttime occupancy of 57.3%¹
- **Assumptions correlate to energy savings of 21.3%**

Cost-Effectiveness Analysis

Incremental Costs

- Incremental First Cost
 - **Total Incremental First Cost (\$50)**
- Incremental Maintenance Costs over 15-year period of analysis
 - **Total Incremental Maintenance Cost (\$0)**
- **Total Incremental Cost over 15-year period of analysis = \$50**

Cost Effectiveness Analysis

Incremental Cost Savings (Benefits)

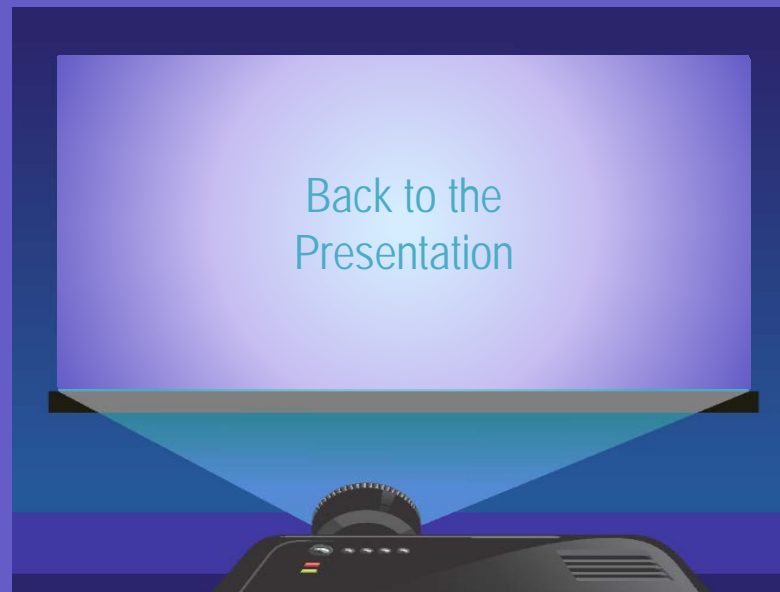
- Energy Cost Savings over 15-year TDV period of analysis
 - **TDV Energy Cost Savings = range of \$71 to \$167 depending on fixture wattage and space type**
 - *Energy cost savings explained in more detail in following slides.*
- **Life Cycle Cost Savings (Benefit) over 15-year period of analysis = range of \$21 to \$117**

Feedback on incremental and maintenance cost



Let's talk about...

Benefit-to-Cost Ratio



Benefit-to-Cost Ratio

Fixture Wattage	Benefit-to-Cost
30	1.4

Cost Effective at 30 Watts and above

If Benefit-to-Cost Ratio is over 1, measure is cost effective.

Benefit-to-Cost Ratio

Space Type at 30 Watts	Average Occupancy Rate at Night	Benefit-to-Cost
Large Office	12.6%	2.9
Big Box (non-24hr)	60.8%	1.3
Big Box (24hr)	98.0%	.07
Fast Food Restaurant	68.5%	1.06
K-12 School	16.1%	2.8
Office Campus	56.0%	1.5
Office Building B	56.0%	1.5
Outdoor Shopping Center	90.7%	.31

Benefit-to-Cost Ratio depends heavily on occupancy rate

Results are inconclusive.
How to approach the issue of outdoor lighting in 24-hour facilities?
We are open to your feedback.

Energy Savings Per Luminaire

Space Type	TDV Energy Savings (TDV kBtu)	15-Year TDV Energy Cost Savings (\$2020)
Large Office	1,642	\$146
Big Box (non-24hr)	736	\$66
Big Box (24hr)	38	\$3
Fast Food Restaurant	593	\$53
K-12 School	1,577	\$140
Office Campus	827	\$74
Office Building B	826	\$73
Outdoor Shopping Center	174	\$16

Feedback on incremental cost and energy savings



Let's talk about...

Next Steps



6. Next Steps

Next Steps

- Please send any additional feedback within 2 weeks to:
 - CASE Author (see contact info at end of this presentation)
 - Info@title24stakeholders.com
- Keep an eye on Title24Stakeholders.com for:
 - Presentations from today's meeting
 - Draft Code Change Language
 - Notes from today's meeting
 - Draft CASE Report (will be posted in April)

Thank you.

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Appendix

References

- [Title24Stakeholders.com](https://www.title24stakeholders.com)
- [EnergyCodeAce.com](https://www.energycodeace.com)
 - See [Reference Ace](#) for 2016 Standards, Appendices, and Compliance Manuals
- [California Energy Commission 2019 Standards Webpage](#)
- List references that will be available on Adobe Connect during meeting