TITLE 24, PART 6 | 2028 CODE CYCLE

Indoor Lighting Controls

Codes and Standards Enhancement (CASE) Proposal

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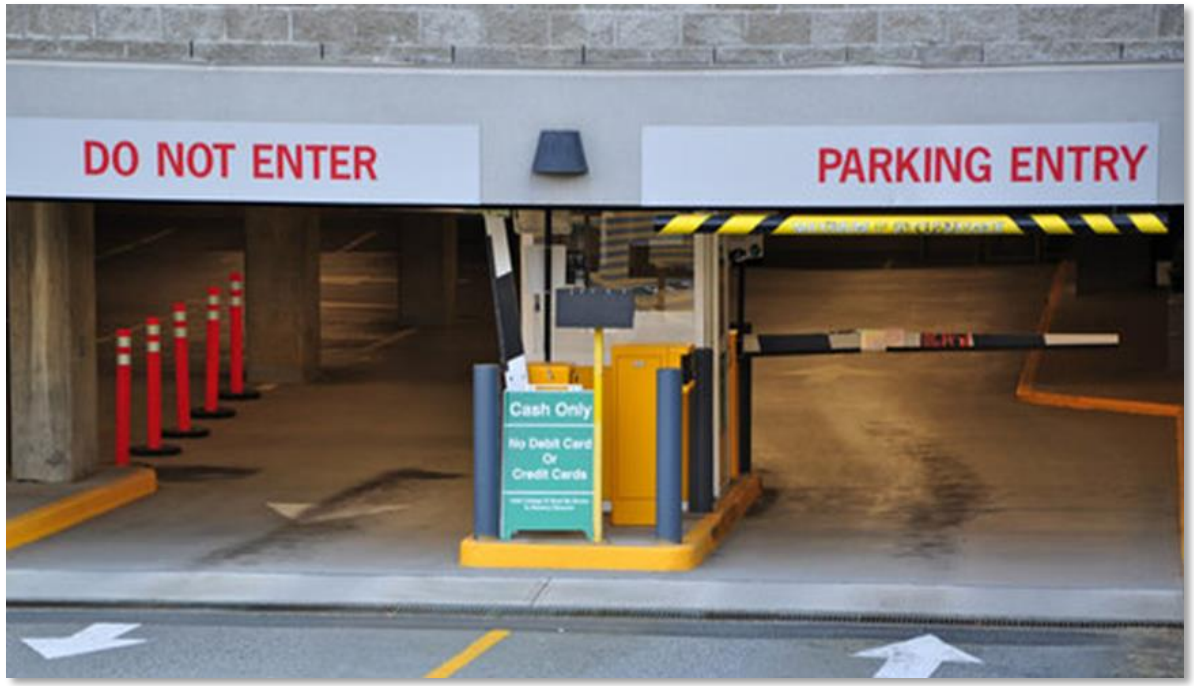
CALIFORNIA ENERGY CODES & STANDARDS
A STATEWIDE UTILITY PROGRAM

Measure 1: Parking Garage Daylight Adaptation Zones Nighttime Controls

Measure 1 Overview

- **Current Title 24, Part 6 Requirements:** Daylight adaptation zones (LPD 1.0 W/ft^2), can be on at 100% power at all times
- **Proposed change**: Require lighting in daylight adaptation zones to be reduced to the same level as the rest of the parking area between sunset and sunrise



High LPD Daylight Adaptation Zone Lighting visible in parking garage entry on right.

Background Information & Current Market Conditions

- **Promotes safety and best practice design while reducing energy use**
  - IES RP-8 *Recommended Practice: Lighting Roadway and Parking Facilities*
    Provide a higher light level (~50 fc) from the garage entrance to ~66 ft deep inside the garage (a.k.a. the daylight adaptation zone) to mitigate a large change in adaptation level for human eyes transitioning **from full daylight to low interior light level**
  - The adaptation is not needed during nighttime
  - Saves energy by reducing the light level in the daylight adaptation zone during nighttime
- **The same requirements are already in the national standards (ASHRAE 90.1) and other model codes (IECC) for several code cycles**
  - Practitioners with national project exposure may already have experience

What's New Since Our Last Stakeholder Meeting?

New / Updated

- ✓ Estimated Useful Life
- ✓ Preliminary Incremental First & Maintenance Costs
- ✓ Preliminary Cost-Effectiveness Results & Benefit-to-Cost Ratio
- ✓ Preliminary Statewide Energy & Energy Cost Savings

Still Under Consideration

- Distribution of integrated parking garages
- Adaptation zone lighting design practices

Technical Considerations

- **May be achieved in multiple ways:**
  - Reduce the lighting power in the daylight adaptation zone from sunset to sunrise (continuous dimming is commonly available for luminaires)
  - Provide a separate layer of lighting for daylight adaptation that is turned off from sunset to sunrise
  - Or some combination of the above

Poll

In a two-way entrance/exit, is the daylight adaptation zone sized for the lighting to cover both sides?

- ☐ Never
- ☐ Rarely
- ☐ Sometimes
- ☐ Often
- ☐ Always
- ☐ Not sure

Poll

What percentage of commercial buildings in dense urban areas feature integrated parking garages?

- ☐ 5%
- ☐ 10%
- ☐ 25%
- ☐ 35%
- ☐ 50%
- ☐ More than 50%

* Integrated parking garages are garages that are part of a building structure, such as an office building with the first few stories designed as a dedicated parking garage.

Preliminary Impact Estimates

- Key methodology
  - Spreadsheet-based modeling and analysis framework
  - Based on full-load hour reduction estimate and the CEC 2029 construction forecasts
- Unit savings: 3.88 kWh/ft^2
- First-year statewide impact

	Impacted Floor Space (ft^2)	Electricity Savings (GWh)	Peak Electrical Demand Reduction (MW)	30yr Present Valued Long-term System Cost Savings (Million 2029 PV$)
New Construction & Additions	199,125	0.8	-	$8.01
Alterations	610,313	2.4	-	$24.46
Total	**809,438**	**3.1**	**-**	**$32.47**

Information Still Needed

- How big is the daylight adaptation zone?
  - What is the percentage of daylight adaptation zones out of the entire parking structure?
  - Is daylight adaptation zone lighting composed of separate/different fixtures from the main parking area lighting?
  - How often do these DA-zone fixtures have dimming capacity?
  - In a two-way entrance/exit, does the DA-zone lighting cover both sides?
  - What is the average electrical run for garage entrance lighting?
- What percentage of commercial buildings in dense urban areas feature integrated parking garages?

Please share in the chat or follow up with the team.

Measure 2: Require Occupant Sensing Controls in more Spaces

Measure 2 Overview

Current Title 24 Requirements:

- Timeclock schedule-based controls are allowed in spaces that are not required to use occupant sensing controls

Proposed change:

- Identified spaces are required to use occupant sensing controls for partial or full OFF after determined unoccupied.
- HVAC occupied standby controls are required in those spaces where ventilation can be shut off.

Newly Considered Spaces

- Computer room
- Exercise/fitness and gymnasium area
- Financial transaction area
- Laboratory
- Lobby, main entry
- Lounge, breakrooms, or waiting area

What's New Since Our Last Stakeholder Meeting?

New / Updated

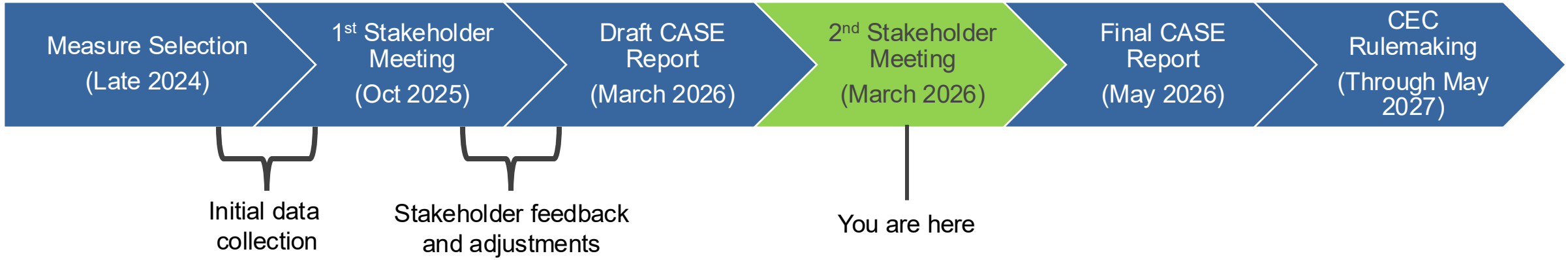
- ✓ Estimated Useful Life

In Progress

- ✓ Incremental First & Maintenance Costs
- ✓ Cost-Effectiveness Results & Benefit-to-Cost Ratio
- ✓ Statewide Energy & Energy Cost Savings

Still Under Consideration

- Mechanical stakeholder feedback on HVAC occupied standby implementation



Current vs. Considered Spaces

- Space types under consideration were refined based on stakeholder feedback from lighting designers and facility managers.
- Ongoing conversations with mechanical stakeholders will further refine this list.

Currently Required Spaces	Considered Spaces
▪ Classroom, lecture, training, vocational area ▪ Conference and meeting area ▪ Corridor area ▪ Multipurpose room < 1,000 sf ▪ Library stacks area ▪ Office area ▪ Parking garage area ▪ Restrooms ▪ Stairwell ▪ Warehouse	▪ Computer room ▪ Exercise/fitness and gymnasium area ▪ Financial transaction area ▪ *Laboratory* ▪ Lobby, main entry ▪ Lounge, breakrooms, or waiting area ~~▪ Hotels~~ ~~▪ Theatrical spaces~~

Poll

Do you believe it is appropriate to require occupant sensing controls to trigger HVAC standby mode in addition and alteration projects?

- ❑ Yes — should apply to all qualifying addition and alteration projects
- ❑ Yes — but only when a new HVAC system is installed as part of the project
- ❑ No — should not be required for additions and alterations
- ❑ Unsure / Need more information (Please provide detailed questions in chat)

Poll

In recent projects, where have you installed occupant sensing controls even when not required by code?

- ☐ Computer room
- ☐ Exercise/fitness and gymnasium area
- ☐ Financial transaction area
- ☐ Laboratory
- ☐ Lobby, main entry
- ☐ Lounge, breakrooms, or waiting area
- ☐ Other (send details in chat)

Poll

Based on your experience, how often are occupant sensing controls voluntarily installed when not required by code in NEW CONSTRUCTION?

- ☐ Rarely (0–2% of projects)
- ☐ Occasionally (3–9% of projects)
- ☐ Sometimes (10–15% of projects)
- ☐ Moderately often (16–50% of projects)
- ☐ Often (51–75% of projects)
- ☐ Very often (76–100% of projects)
- ☐ Not sure / not applicable

Poll

Based on your experience, how often are occupant sensing controls voluntarily installed when not required by code in ALTERATIONS?

- ☐ Rarely (0–2% of projects)
- ☐ Occasionally (3–9% of projects)
- ☐ Sometimes (10–15% of projects)
- ☐ Moderately often (16–50% of projects)
- ☐ Often (51–75% of projects)
- ☐ Very often (76–100% of projects)
- ☐ Not sure / not applicable

Preliminary Impact Estimates

- Include only Small Office prototype, with additional results to be included for Large Office, Medium Office, and Primary School prototype in Final analysis

- Per unit energy impact and cost-effectiveness, climate zone dependent
  - **Electricity savings:** 0.12 to 0.14 kWh/ft^2
  - **Natural gas savings:** -0.03 to -0.13 kBtu/ft^2
  - **Benefit-to-cost ratio:** 2.03 to 2.64

- First-year statewide impact

	Impacted Floor Space (Mft^2)	Electricity Savings (GWh)	Peak Electrical Demand Reduction (MW)	30yr Present Valued Long-term System Cost Savings (Million 2029 PV$)
New Construction, Additions & Alterations	2.7	0.36	0.02	$2.03

Are there additional data points from your projects that could improve this analysis?

Examples:

- Cost data
- Energy modeling assumptions
- HVAC integration costs
- Commissioning effort

Please share in the chat or follow up with the team.

Measure 3: Reduce Occupant Sensing Control Delay Time

Measure 3 Overview

- **Current Title 24, Part 6 Requirements:** Maximum occupant sensing control time delay is 20 minutes
- **Proposed change**: Reduce the maximum occupant sensing control time delay to 15 minutes
- Impact to HVAC occupied standby requirements under consideration

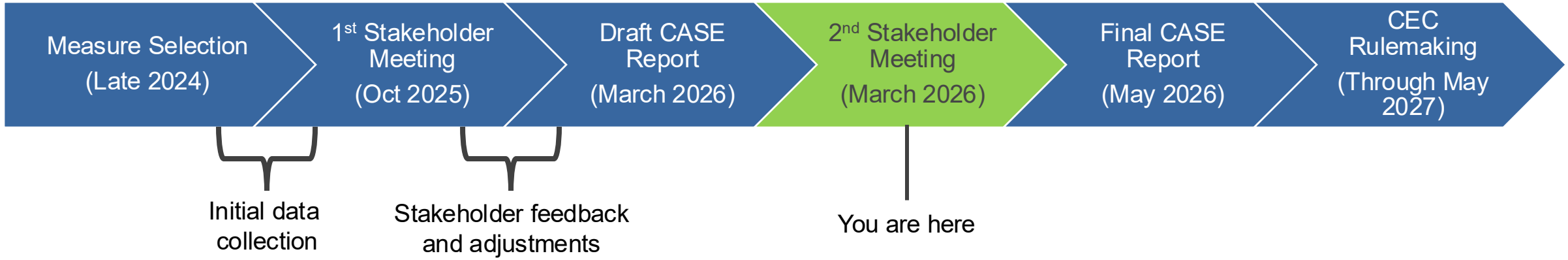
What's New Since Our Last Stakeholder Meeting?

New / Updated

- ✓ Estimated Useful Life
- ✓ Preliminary Incremental First & Maintenance Costs
- ✓ Preliminary Cost-Effectiveness Results & Benefit-to-Cost Ratio
- ✓ Preliminary Statewide Energy & Energy Cost Savings

Still Under Consideration

- Align delay times across all occupancy-based control requirements (HVAC occupied standby, laboratory/factory exhaust systems)



Background, Market Conditions & Technical Considerations

Objective: Reduce occupant sensing time delay from the current 20 minutes to 15 minutes

- Occupant sensing controls are a well-understood and easy-to-implement control strategy in all lighting control systems
- Many occupancy sensors/controls already provide a 15-minute option for time delay setting, and some set the factory default at 15 minutes
- The same requirement has been added in the latest update to the national standards (ASHRAE 90.1) – Addendum bd to ASHRAE 90.1-2022
- Possible prevalent false-offs in specific applications and space types if occupant sensing time delay is reduced to 15 minutes

Poll

What is your typical maximum occupancy sensor delay time specified in construction documents?

- ☐ <10 minutes
- ☐ 10 minutes
- ☐ 15 minutes
- ☐ 20 minutes
- ☐ Not sure

Poll

How often are lighting occupancy sensors integrated with occupancy sensors for other systems (e.g. occupied standby for HVAC)?

- ☐ Almost never
- ☐ Rarely
- ☐ Sometimes
- ☐ Often
- ☐ Not sure

Preliminary Impact Estimates

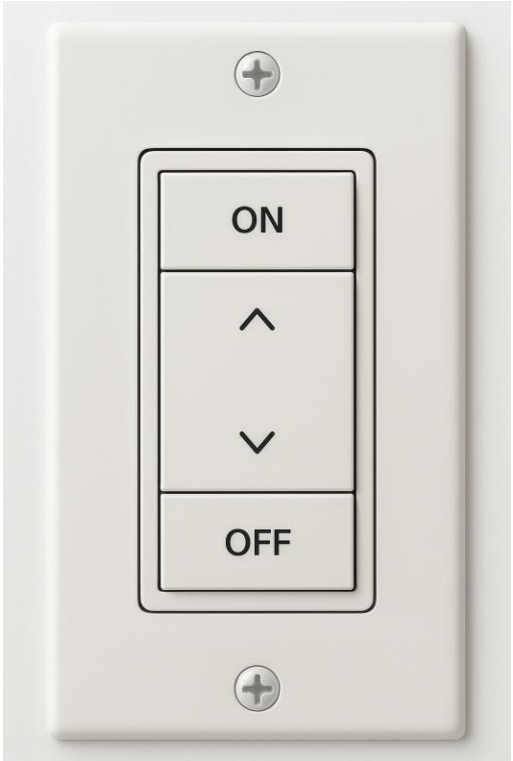
- Key methodology
  - Spreadsheet-based modeling and analysis framework
  - Based on full-load hour reduction estimate and the CEC 2029 construction forecasts
- Unit savings: 0.01 to 0.08 kWh/ft^2, depending on building types.
- Highly cost-effective due to no incremental costs.
- First-year statewide impact

	Impacted Floor Space (Mft^2)	Electricity Savings (GWh)	Peak Electrical Demand Reduction (MW)	30yr Present Valued Long-term System Cost Savings (Million 2029 PV$)
New Construction & Additions	126.8	7.2	0.3	$373
Alterations	475.7	25.6	1.5	$1422
Total	**602.5**	**32.8**	**1.8**	**$1795**

Measure 4: Update Multilevel Lighting Controls Requirements

Measure 4 Overview

- **Current Title 24, Part 6 Requirements:** Unclear to the energy code users if multilevel lighting control is calling for manual dimmers or continuous dimming capabilities that other controls can use
- **Proposed change:**
  - Explicitly call out manual dimmer requirements
  - Directly require continuous dimming for related controls
  - Move away from the term “multilevel lighting controls”
  - Lower the trigger for requiring manual dimmers
  - Require continuous dimming for all daylight responsive controls



What's New Since Our Last Stakeholder Meeting?

New / Updated

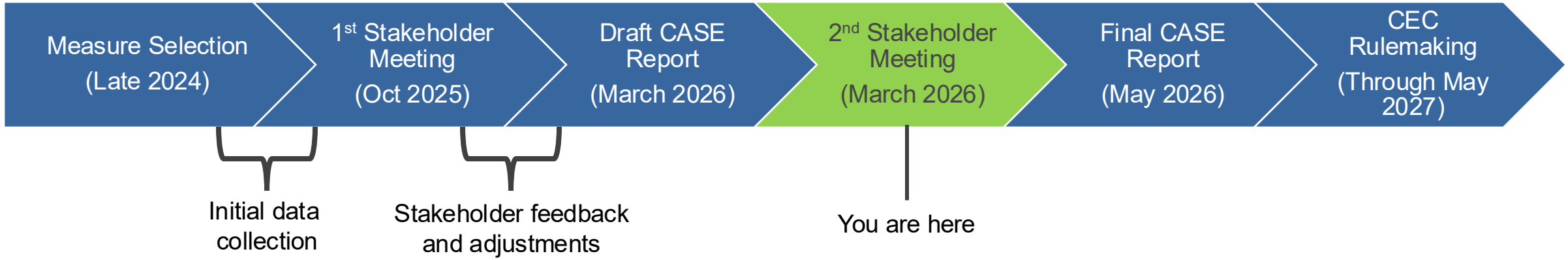
- Switched from LPD-based trigger to wattage-based trigger
- Preliminary incremental first & maintenance costs
- Preliminary energy and cost-effectiveness results for requiring manual dimmers

In Progress

- Energy and cost-effectiveness results for requiring continuous dimming for all daylight responsive controls

Still Under Consideration

- Use of scene controls to comply with manual dimmer requirement



Original Proposal
Discussed in First Stakeholder Meeting

Applies to <u>Group R occupancies</u> only

130.1(b) Multilevel Lighting Controls

Required for general lighting in spaces
- 100 ft^2 or larger
- Lighting load greater than 0.5 W/ft^2
- Except for
  - Spaces has only one luminaire
  - Restrooms
  - Healthcare facilities
  - HID and induction light sources

Reminder: Due to AB 130, stringency of Group R occupancies (e.g., leasing offices, corridors, lobbies in a multifamily building) cannot be changed until 2031.

Applies to <u>spaces in nonresidential buildings</u>

130.1(a) Manual Controls

[New] 130.1(a)4 Manual Dimmer Requirements
- General lighting in spaces with a lighting load **0.4 W/ft^2** or greater
- Except for
  - Parking garages, stairwells, corridors, manufacturing work areas, chipping and receiving areas, laboratories, kitchen, and restrooms
  - Healthcare facilities
  - HID and induction light sources

130.1(d) Daylight Responsive Controls

- No longer reference 130.1(b)
- Continuous dimming required with no exceptions

Updated Proposal

Completely removed

~~130.1(b) Multilevel Lighting Controls~~

~~Required for general lighting in spaces~~
- ~~100 ft^2 or larger~~
- ~~Lighting load greater than 0.5 W/ft^2~~
- ~~Except for~~
  - ~~Spaces has only one luminaire~~
  - ~~Restrooms~~
  - ~~Healthcare facilities~~
  - ~~HID and induction light sources~~

130.1(a) Manual Controls

[New] 130.1(a)4 Manual Dimmer Requirements
- General lighting load in spaces exceeds
  - 75 watts for **Group R occupancies**
    Identical stringency as the original 0.5 W/ft^2 trigger (same long-term system cost)
  - 50 watts for **spaces in nonresidential buildings**
- Except for
  - Parking garages, stairwells, corridors, manufacturing work areas, shipping and receiving areas, laboratories, kitchen, and restrooms
  - Healthcare facilities
  - HID and induction light sources

130.1(d) Daylight Responsive Controls

- No longer reference 130.1(b)
- Continuous dimming required with no exceptions

Poll

Which option for triggering manual dimmer requirements would you support?

a. Wattage-based triggers for both residential and nonresidential spaces (our updated proposal; stringency for residential trigger is equivalent to 2025 code)
b. Wattage-based trigger for nonresidential spaces, and the original LPD-based trigger for residential spaces
c. LPD-based triggers for both residential and nonresidential spaces (same trigger for residential spaces and more stringent trigger for nonresidential spaces

Poll

What if scene controls are used in the space?

Should scene controls (without raise/lower buttons/sliders for continuous dimming) be considered comply with the manual dimmer requirement?

a. Yes
b. Yes, except for [explain the conditions in chat]
c. No

Continuous Dimming Requirements

- All daylight responsive controls for LED lighting must be implemented with continuous dimming
  - No exception provided; daylight responsive controls with stepped switching are no longer an option
  - Increased user satisfaction
  - Impacted spaces: low LPD (0.5 W/ft^2 or lower), i.e., low design illuminances
  - Cost-effectiveness may be a concern in certain climate zones and control configurations
    - Stepped switching (current): OFF, i.e., 0 lighting power when daylight is abundant
    - Continuous dimming (proposed): dimmed to 10% power when daylight is abundant

Preliminary Impact Estimates (Manual Dimmers)

- Key assumptions
  - 5-9% savings; engineering estimate on how actively manual dimmers will be used for different space types
  - Professional estimate on the portion of impacted spaces within each building type included in the 2029 CEC construction forecast
- Unit savings: 0.091 to 0.583 kWh per watt controlled, depending on space type
- First-year statewide impact

	Impacted Floor Space (Mft^2)	Electricity Savings (GWh)	Peak Electrical Demand Reduction (MW)	30yr Present Valued Long-term System Cost Savings (Million 2029 PV$)
New Construction & Additions	6.0	0.7	0.07	$5.65
Alterations	24.8	3.0	0.27	$23.20
Total	**30.8**	**3.7**	**0.33**	**$28.84**

Energy Savings Forecast of Solid-State Lighting in General Illumination Applications. U.S. Department of Energy, December 2019.
Jennings, J. D., Rubinstein, F. M., DiBartolomeo, D., & Blanc, S. L. (2000). Comparison of Control Options in Private Offices in an Advanced Lighting Controls Testbed. *Journal of the Illuminating Engineering Society*, *29*(2), 39–60.

Comment Letters: Recommended Code Cleanup

Partial Daylight Acceptance Testing

Recommendation: **Update the Partial Daylight test method for the Daylight Responsive Control Acceptance Test**

Possible outcomes:

1. Keep both original Partial Daylight Test and Alternate Partial Daylight Test unchanged
2. Keep both original Partial Daylight Test and Alternate Partial Daylight Test, but update the original Partial Daylight Test to reflect the change in 2022 daylight responsive controls that require dimming to 10% power or lower
   The original Partial Daylight Test is based on pre-2022 requirements of dimming to 60% power or lower
3. Remove the original Partial Daylight Test and make the Alternate Partial Daylight Test the only test method

Acceptance Testing for LLLC

Recommendation: **Improve lighting control acceptance test methods for luminaire-level lighting controls (LLLC)**

- When LLLC is used as the control solution to meet mandatory control requirements
- Provide additional guidance for occupant sensing and daylight responsive controls testing
  - “Coordinated” vs. “non-coordinated” LLLC system configuration
  - Group sampling requirement and strategies
  - Full daylight test, especially when using a flashlight to create required test condition

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More information on
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