Round 2

Welcome to the California Statewide Codes and Standards Enhancement (CASE) Team's Stakeholder Meeting on

Lighting Proposals

We will begin shortly.

In the meantime, please fill out the polls below.

CALIFORNIA ENERGY CODES & STANDARDS
A STATEWIDE UTILITY PROGRAM

Pacific Gas and Electric Company

SOUTHERN CALIFORNIA EDISON
An EDISON INTERNATIONAL® Company

SDGE
A Sempra Energy utility

LA DWP Los Angeles Department of Water & Power

SMUD

Welcome: Connect Your Audio

Audio – there are **three** options for connecting to the meeting audio:

To view options, click on the  icon on the top ribbon, then select *Connect My Audio.*

1. **Dial-out:** receive a call from the meeting. *Please note this feature* ***requires a direct line.***
2. **Dial-in:** dial-in to the conference via phone. Conference phone number and room number code provided. *Please then* ***identify your line*** *by entering your unique user ID on your phone.*
3. Use the **microphone** from your computer/device.

Above*: audio conference settings pop-up box*

2022 TITLE 24 CODE CYCLE, PART 6

Second Utility-Sponsored Stakeholder Meeting

Lighting

March 3, 2020

CALIFORNIA ENERGY CODES & STANDARDS

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Meeting Guidelines

Part 1 of 3 - Muting

Muting Guidelines:

Once you establish your audio connection please **MUTE** your microphone.

- Please keep yourself **MUTED**.
- Wait for instructions and/or permission to unmute yourself during designated Q&A periods.

Two Options to Mute:

1. **Manually** mute your device, or;
2. Mute your phone or microphone **icon** in the top ribbon of the Adobe Connect window.

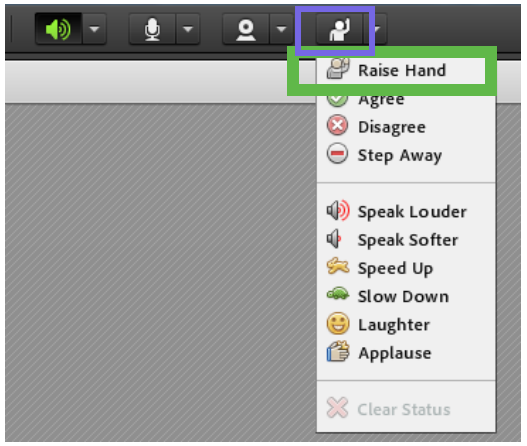
Meeting Guidelines

Part 2 of 3 - Participation

Participation Guidelines:

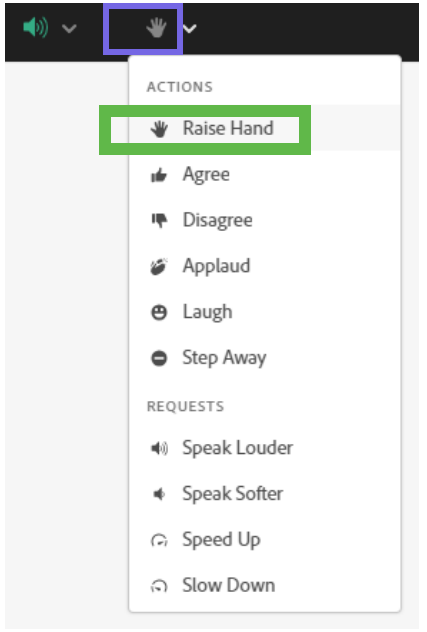
- **Questions & Comments**
  - Click **"*Raise Hand*"** if you would like to speak. Those with a hand raised will be called on by the speaker.
  - All questions and comments are also welcome via the chat window.

- **Other Meeting Feedback**
  - Provide live meeting feedback from the **top toolbar drop-down**.



Above: *feedback view for Adobe Connect app users.*

Below: *feedback view for HTML users.*



Meeting Guidelines

Part 3 of 3 – Discussion Ground Rules

- **We want to hear your thoughts.**
  - Supporting and opposing viewpoints are welcome.
- **When making comments, please:**
  1. Unmute yourself;
  2. Clearly state your name and affiliation prior to speaking; and
  3. Place yourself back on mute when done speaking.
- **Calls are recorded** for note development, recordings will not be publicized.
- Notes and presentation material will be posted on Title24Stakeholders.com/events.

Agenda

1	**Meeting Guidelines**	*8:30 am*
2	**Opening Remarks** from the California Energy Commission	*8:35 am*
3	**Overview & Welcome** from the Statewide Utility Team	*8:40 am*
4	**Presentation I:** Nonresidential and Multifamily Outdoor Lighting Sources	*8:45 am*
5	**Presentation II:** Nonresidential Daylighting	*10:15 am*
6	**Presentation III:** Nonresidential Grid Integration: Demand Responsive Lighting	*10:45 am*
7	**Presentation I:** Nonresidential Indoor Lighting	*11:15 am*
8	**Closing**	*11:45 am*

Lighting Code Cleanup Initiative

The Statewide CASE Team and the **California Energy Alliance** have convened a working group to propose clarifying edits to *Sections 130.1* and *130.2* of the 2019 Title 24, Part 6 lighting code, with the goal of increasing readability and improving code compliance.

Learn more and **get involved** at:

https://title24stakeholders.com/contact-us/2019-code-cleanup-initiative/

Opening Remarks:
California Energy Commission

Policy Drivers: Building Standards

The following policy documents establish the goal for new building standards:

- **2008 CPUC/CEC Energy Action Plan** – ZNE for residential buildings by 2020 and nonresidential buildings by 2030
- **SB 100** – Clean electricity by 2045
- **B-55-18** – Governor Jerry Brown's Executive Order to achieve carbon neutrality
- **AB 3232** – Assess the potential for the state to reduce the emissions of greenhouse gases from the state's residential and commercial building stock by at least 40 percent below 1990 levels by January 1, 2030

2022 Updated Standards Schedule

Estimated Date	ACTIVITY OR MILESTONE
November 2018 – November 2019	Updated Weather Data Files
November 2018 – December 2019	Metric Development
November 2018 - July 2019	Measures Identified and Approved
April 24, 2019	Present the Efficiency Measure Proposal Template for public to submit measures
October 17, 2019	Compliance Metrics and Climate Data Workshop
August 2019 – November 2019	First Round of Utility-Sponsored Stakeholder Workshops
January 2020	Research Version of CBECC Available with new weather data files and updated metric
March 2020 – April 2020	Second Round of Utility-Sponsored Stakeholder Workshops
March 10, 2020	Staff Workshop on the proposed changes for the ATTCP program
March 26, 2020	Staff Workshop on the EDR1
March 2020 – May 2020	All Initial CASE/PUBLIC Reports Submitted to Commission
July 2020 – August 2020	All Final CASE/PUBLIC Reports Submitted to the Commission
August 2020 – October 2020	Commission-Sponsored Staff Workshops
September 2020 – November 2020	Express Terms Developed (including New Multifamily Section)
February 2021	45-Day Language posted and sent to list serve, Start of 45-Day review/comment period
March 2021	Lead Commissioner Hearing
July 2021	Adoption of 2022 Standards at Business Meeting
September 2021	Final Statement of Reasons Drafted and Approved
July 2021	Adoption of CALGreen (energy provisions) - Business Meeting
December 2021	Approval of the Manuals
October 2021	Final Rulemaking Package delivered to CBSC
December 2021	CBSC Approval Hearing
January 2021	Software, Compliance Manuals, Electronic Documents Available to Industry
January 1, 2023	Effective Date

2022 Standards Contact Info

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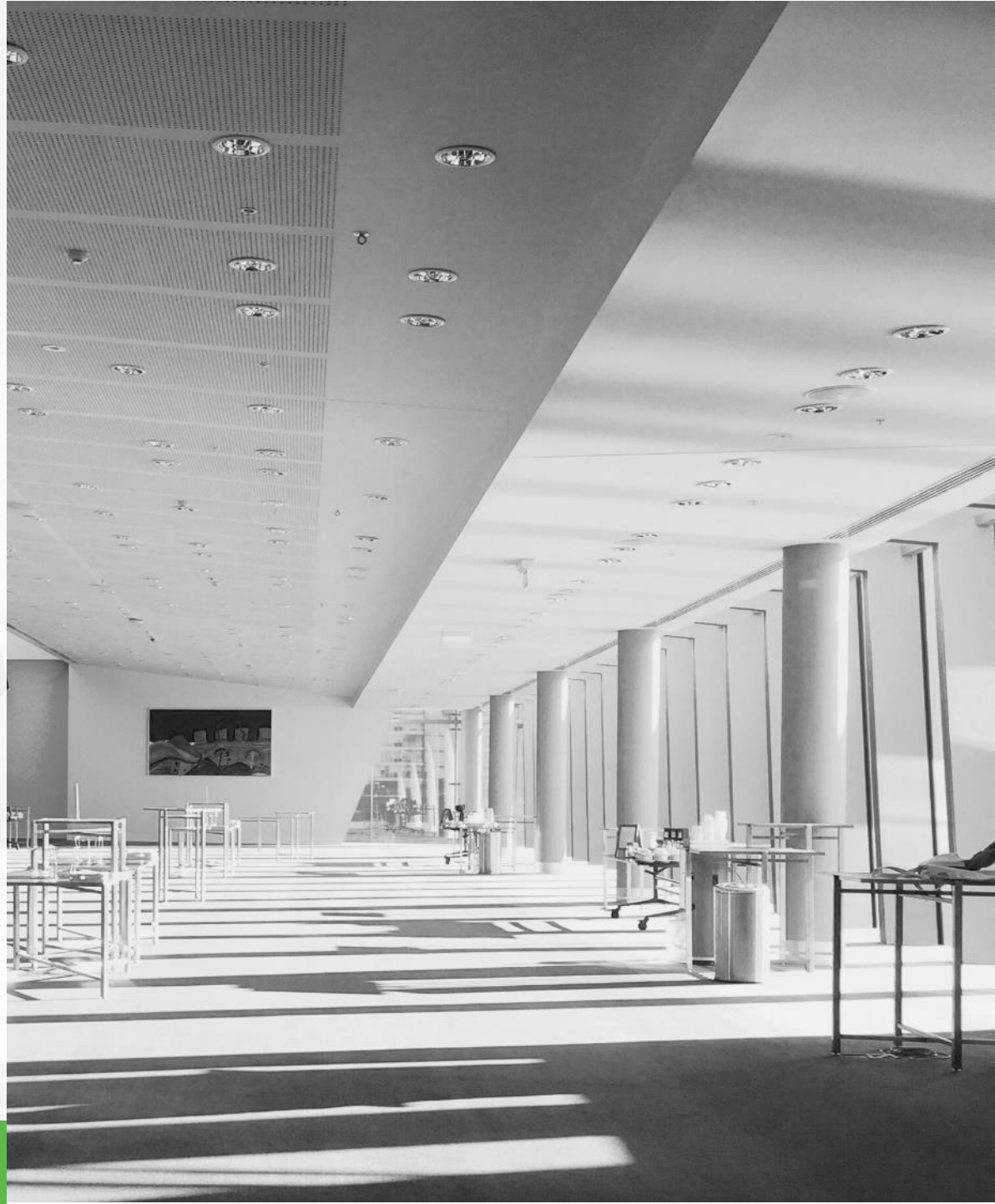
More information on pre-rulemaking for the 2022 Energy Code at:
https://www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards/2022-building-energy-efficiency

Title 24, Part 6 Overview

Kelly Cunningham
Codes and Standards
Pacific Gas & Electric



Statewide Utility Codes and Standards Team

Actively support the California Energy Commission in developing proposed changes to the Energy Code (Title 24, Part 6) to achieve significant statewide energy use reductions through the development of code change proposals for the 2022 cycle that are:

Feasible | Cost effective | Enforceable | Non-proprietary

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LADWP Los Angeles Department of Water & Power

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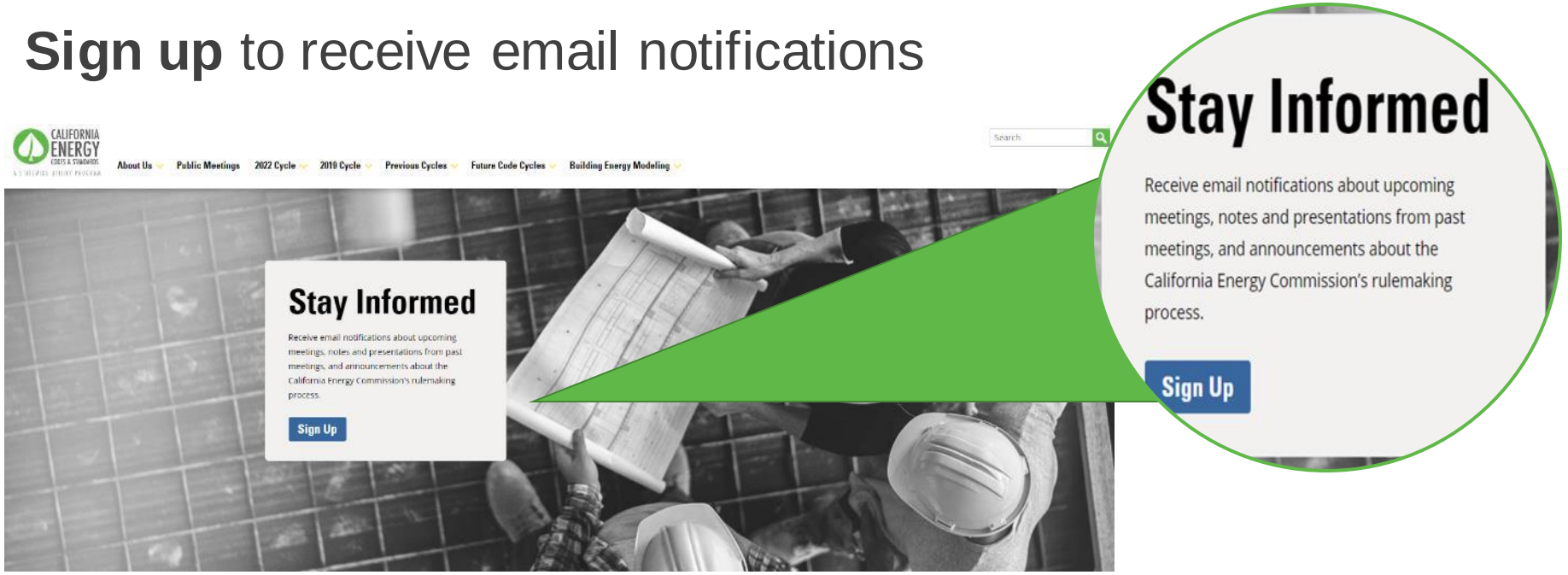
Utility-Sponsored Stakeholder Meetings

- All meetings can be attended **remotely**
- Check Title24Stakeholders.com/events for information about meetings and topic updates
- **Sign up** to receive email notifications



Second Round Utility-Sponsored Stakeholder Meetings

Meeting Topic	Building Type	Date
Lighting	NR/MF	Tuesday, March 3, 2020
Single Family Whole Building	SF	Thursday, March 5, 2020
Nonresidential and Single Family HVAC Part 1: Data Centers, Boilers, Air Distribution, Variable Capacity	NR/SF	Thursday, March 12, 2020
Water Heating and Multifamily All Electric Package	MF	Tuesday, March 17, 2020
Single Family Grid Integration	SF	Thursday, March 19, 2020
Multifamily HVAC and Envelope	MF	Thursday, March 26, 2020
Covered Processes Part 1: Refrigeration System Opportunities	NR	Thursday, April 2, 2020
Nonresidential HVAC and Envelope Part 2: Reduced Infiltration, HVAC Controls (Air Efficiency, DOAS)	NR	Tuesday, April 14, 2020
Covered Processes Part 2: Controlled Environmental Horticulture	NR	Thursday, April 16, 2020
Nonresidential Envelope Part 1: High Performance Envelope	NR	Thursday, April 23, 2020

Sign up for all meetings at title24stakeholders.com/events/

2022 Code Cycle – Key Milestones

CEC Milestone

Utility Team Milestone

Oct. 2018 – Feb. 2019:
Stakeholder outreach to request input on scope 2022 code cycle

Oct. 2018 – Feb. 2019:
Select 2022 Measures

August – Nov. 2019:
First round of utility-sponsored stakeholder meetings

April. 2019:
Work plans completed; Begin work on CASE Reports

Mar. 2020 – Apr. 2020:
Second round of utility-sponsored stakeholder meetings

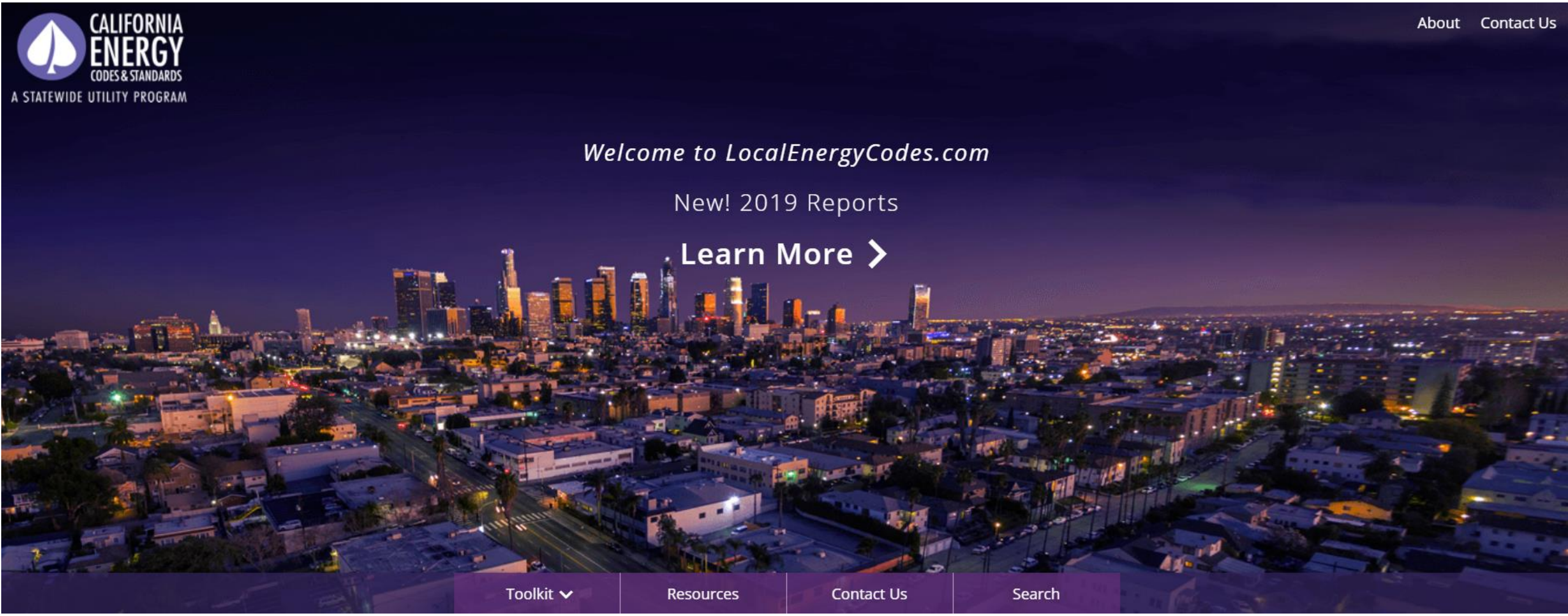
Apr. – May. 2020:
Draft CASE Reports posted for public review

July 2020 – August 2020:
Final CASE Reports completed

June – Dec. 2020:
CEC Pre-rulemaking

Dec. 2020 - May 2021:
CEC Rulemaking

May 2021:
2022 Standards Adopted



The **Codes and Standards Reach Codes Program** provides technical support to local jurisdictions considering adopting a local energy and efficiency ordinance

www.LocalEnergyCodes.com

This program is funded by California utility customers under the auspices of the California Public Utilities Commission and in support of the California Energy Commission.

Thank You

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CALIFORNIA ENERGY CODES & STANDARDS
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2022 CALIFORNIA ENERGY CODE (TITLE 24, PART 6)

Outdoor Sources

Codes and Standards Enhancement (CASE) Proposal

Nonresidential | Outdoor Lighting Sources

Annie Kuczkowski & Nancy Clanton, *Clanton and Associates, Inc.*
Christopher Uraine, *Energy Solutions*
Michael Mutmansky, *TRC Energy Services*

March 3, 2020

CALIFORNIA ENERGY CODES & STANDARDS

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Code Change Proposal: Additional Resources

First-Utility Sponsored Meeting

The Statewide CASE Team held its first utility-sponsored stakeholder meeting for this topic on **September 5, 2019.**

Resources on Title24stakeholders.com

Presentation slides and **Submeasure summary** documents available that cover the following:

- ✓ Measure Background
- ✓ Market Overview & Analysis
- ✓ Technical Feasibility
- ✓ Compliance & Enforcement
- ✓ Draft Code Language

Also available in the **resources tab in today's presentation.**

Submeasure A: Lighting Power Allowances (LPA) for General Hardscapes

Submeasure B: Lighting Zone Reclassification

Submeasure C: Multifamily Lighting Power Allowance Update

Today's Objectives

The focus of today's meeting includes:

1. **Review** Energy and Cost Calculations
2. **Get Feedback** on Technical Feasibility
3. **Review** updates to Code Language

Proposal Background

Code Change Proposal Summary

Submeasure	Type of Change	Software Updates Required	Sections of Code Updated	Compliance Documents Updated
Lighting Power Allowances for General Hardscapes	Prescriptive	N	Section 100.1(b) Section 130.2 Section 140.7	NRCC-LTO-03-E

Description of Changes

- Update general hardscape LPA to align with the Illuminating Engineering Society (IES) Recommended Practice (RP) RP-8-18 Chapter 17 Addendum 1
- Additional allowance for security cameras

Summary of IES Parking Lot Lighting Level Update

IES RP-8-18

- Previously IES RP-20-14
- Adopted in 2014

Surface Material	Horizontal Illuminance (Minimum)	Vertical Illuminance (Minimum)	Uniformity Ratio (Maximum to Minimum)
Asphalt Surface	5 lux	2.5 lux	15:1
Concrete Surface	10 lux	5 lux	15:1

IES RP-8-18 Chapter 17 Addendum 1

- Reverts back to RP-20-98 lighting levels

Surface Material	Horizontal Illuminance (Minimum)	Vertical Illuminance (Minimum)	Uniformity Ratio (Maximum to Minimum)
All Surfaces	2 lux	1 lux	20:1

Energy and Cost Impacts

- Assumptions & Methodology
- Energy Impacts
- Cost Impacts
  - Incremental costs
  - Maintenance costs
  - Energy cost savings
- Cost-effectiveness

Methodology for Energy Impacts Analysis

1. **Per Unit Savings:** calculate power allowance difference between 2019 and 2022 per square foot of outdoor lighting

Calculated per unit savings for **General Hardscape**

2. **Per Unit Savings:** calculate annual electricity savings (kWh) for one square foot of outdoor lighting

3. **Statewide Savings:** multiply square foot savings by 2022 construction forecast

Same methodology used for 2016 and 2019 code cycles

Methodology for Energy Impacts Analysis

Per unit energy savings are per square foot of general hardscape area

Tools Used	Spreadsheet analysis for energy savings, costs, based on 10 studied general hardscape layouts. Lighting software used to confirm general hardscape calculations
General Hardscape Layouts	10 typical layouts (layout A through K)
Lighting Zones Modeled	Lighting Zones 1 through 4 Lighting Zones are independent of climate zones

Assumptions for Cost and Energy Impact Analysis

- **Key Energy Impact Assumptions**
  - LEDs used as source for both baseline (compliant with 2019) and proposed conditions
  - 15-year period of evaluation
  - General hardscape schedule: On 30 minutes before dusk; off 30 minutes after dawn; 50% light reduction after 11:00pm (post occupancy)
- **Statewide Savings Assumptions**
  - No anticipated maintenance: LED luminaire life is greater than 15-year period of analysis
  - Outdoor hardscape is not part of construction forecasts so assumptions are used to convert indoor to outdoor

Definition of Baseline and Proposed Conditions

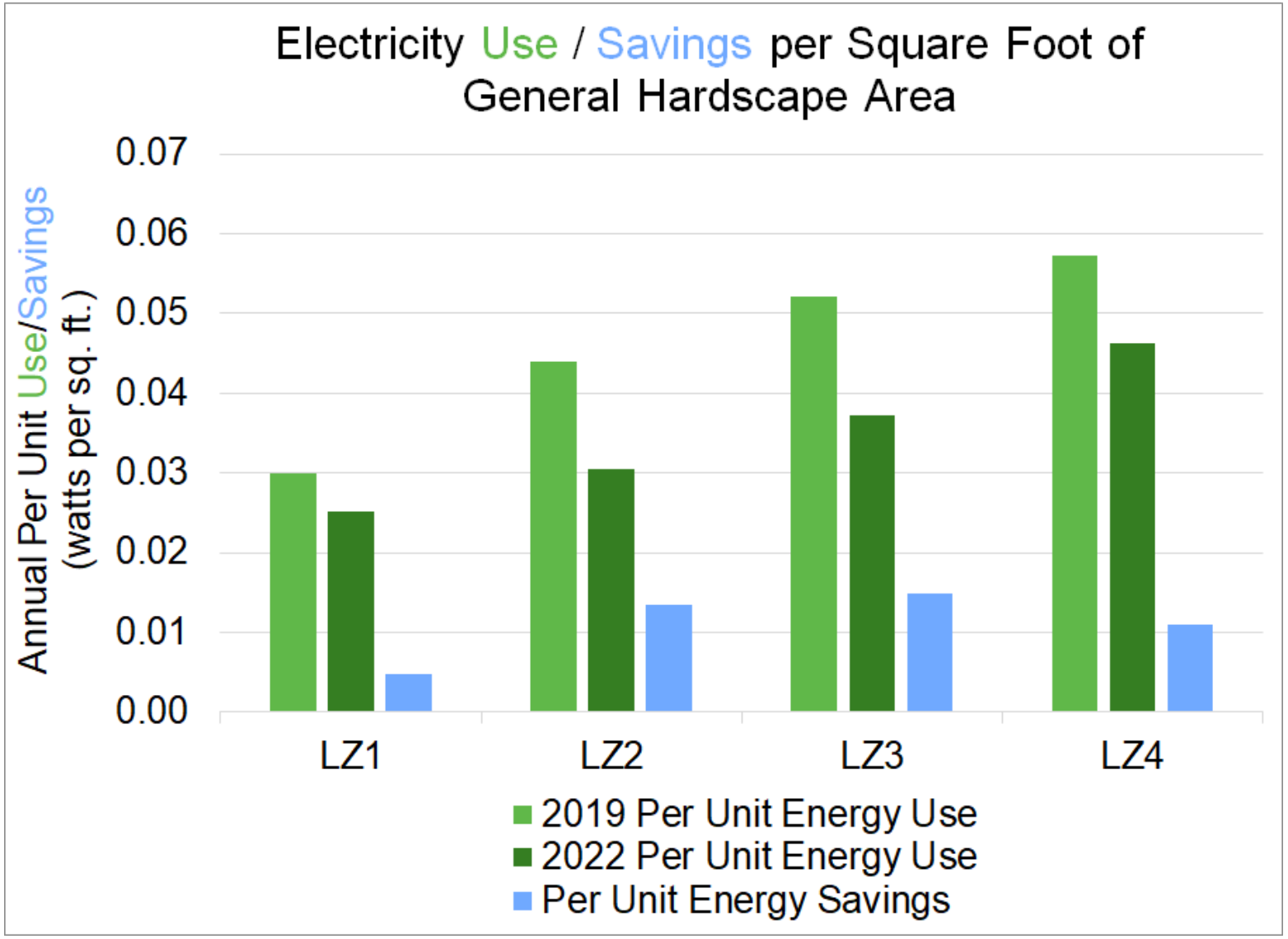
Baseline Conditions

- **2019** Title 24 Part 6 LPAs
- Dusk +30min to Dawn +30min with 50% dimming after hours
- After hours is after 11:00pm

Proposed Conditions

- **2022** Title 24 Part 6 LPAs
- No scheduling change
- No after hours dimming change

Per Unit Energy Savings Results



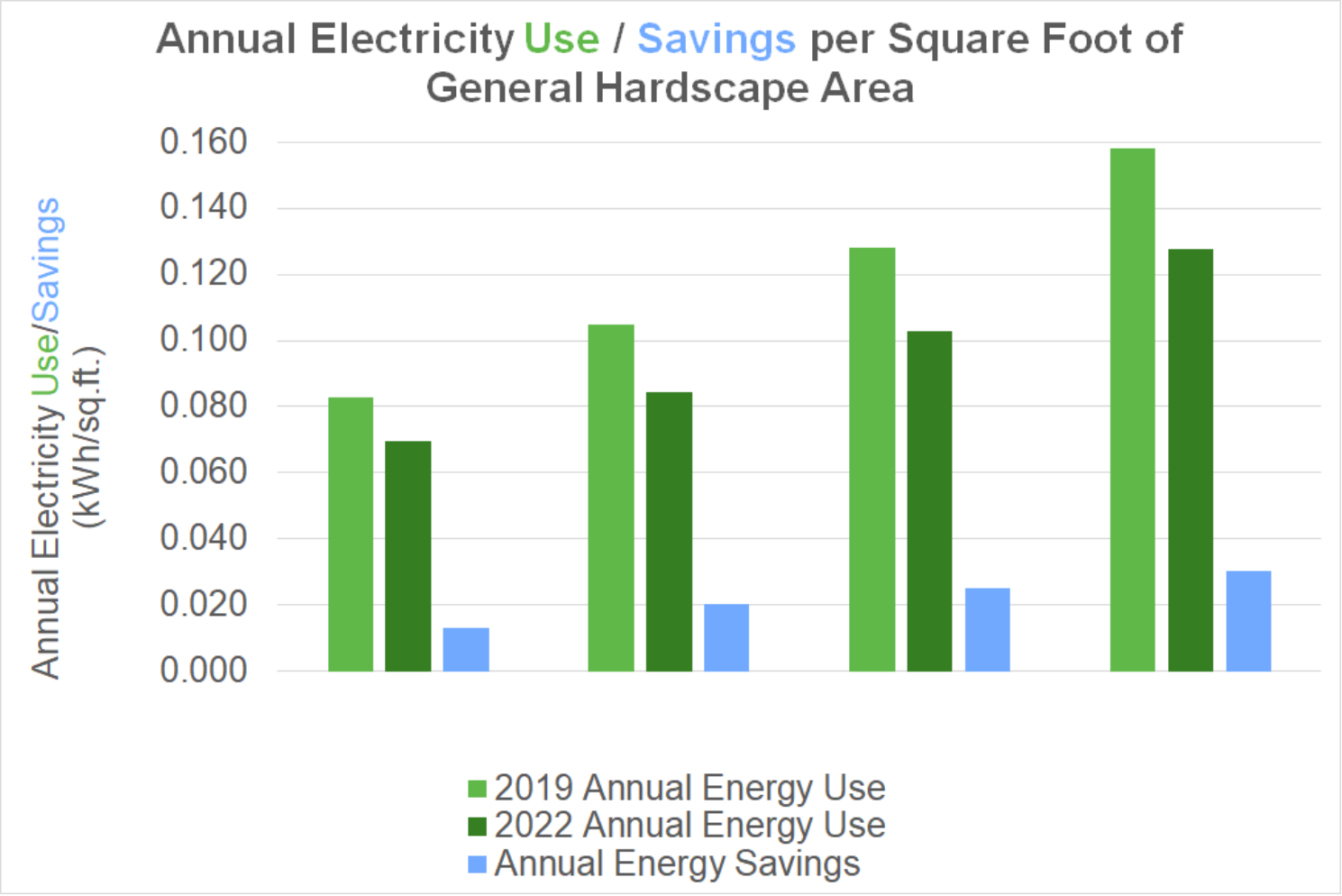
16% - 39%

Power savings per square foot (W/ft^2)

Varies by lighting zone

Annual Electricity Savings Results

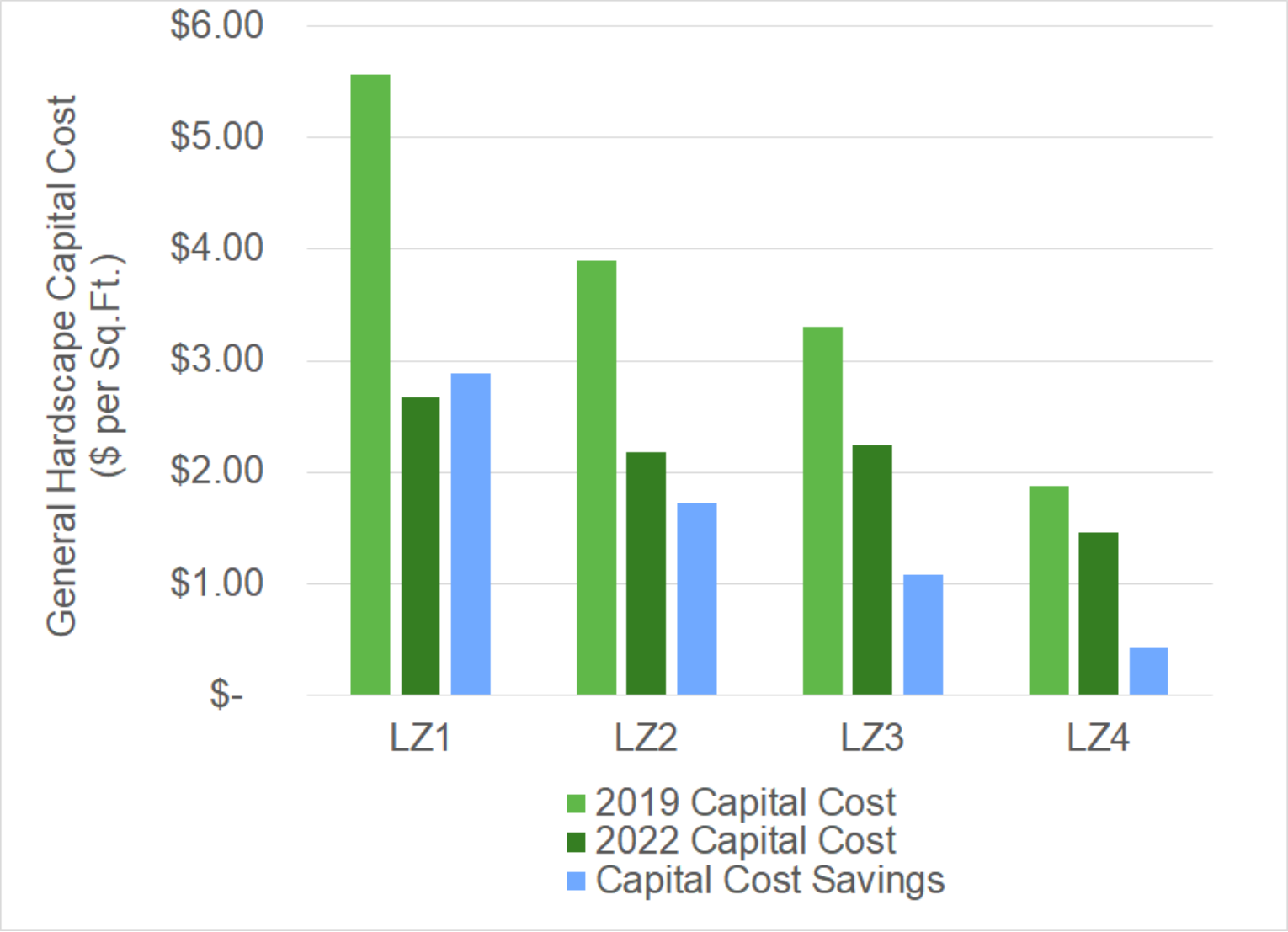
Per Square Foot of General Hardscape Area



0.385 kWh/ft^2

Annual electricity savings – per square foot of general hardscape area

Capital Cost and Savings Per Square Foot



Less Expensive to Comply with Proposed LPAs:

- Reduced recommended lighting levels requires less equipment
- Equipment cost includes: pole, foundation, conduit and wiring cost
- ≤ 24ft poles include controls and control wiring
- LED incremental cost is not applicable since L70 life is greater than 15 years

Assumptions for Statewide Savings Estimates

- **No outdoor construction estimates:** Converted forecasted indoor construction floorspace (by building area) to General Hardscape (outdoor) area using assumptions about hardscape associated with each building type
  - **Building Floorspace to Outdoor Area Assumptions:** developed in 2016 code cycle, used again and refined in 2019 code cycle
  - **2022 code cycle:** will use same assumptions to develop statewide savings estimates
  - **Example:** 830 square feet of warehouse space equals 1 parking space (250 square feet of general hardscape)

Assumptions will be presented in Draft CASE Report. Feedback is appreciated.

Technical Considerations

Technical Considerations – Security Cameras

- IES recommended lighting levels do not consider security cameras
  - Cameras are becoming more prevalent in parking lots
  - Camera illuminance level requirements increase with distance
- Identification capabilities diminish with distance

Do you have data about the prevalence of security cameras in parking lots?

Technical Considerations – Security Cameras

- Identification capabilities diminish with distance
  - Color cameras require the most light
  - Black and white cameras require less light over distance
  - Cameras with IR filters require minimal additional lighting
  - Zoom cameras require less light over distance than non-adjustable cameras

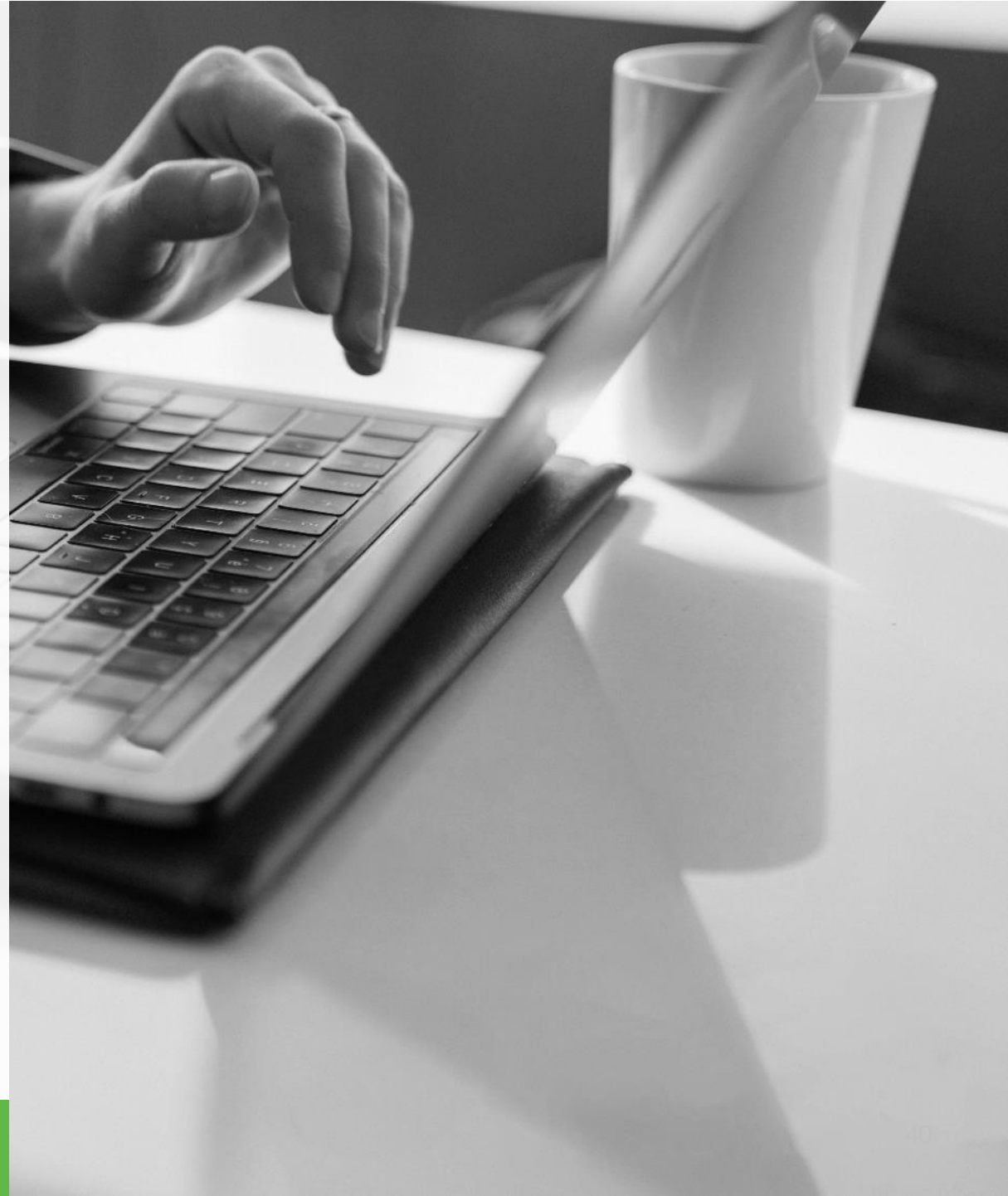
Security Camera Example

Camera Resolution:
- 1920x1080p
- 25/30 fps
- F1.8
- 360° view

Camera Detection	Camera Minimum Illumination (lux)
Color	0.17 lux at 50 IRE F1.8
Black & White	0.04 lux at 50 IRE F1.8
Black & White with IR illumination on	0.0 lux at 50 IRE F1.8

Proposed Code Changes

- Draft Code Change Language



Draft Code Change Language Updates

- **Updated** draft code language for this submeasure is available in the **resources tab**
- General Hardscape LPAs reduced
- Removed surface material distinction
- Security camera adder included

Proposed 2022 LPAs

Type of Power Allowance	Lighting Zone 1	Lighting Zone 2	Lighting Zone 3	Lighting Zone 4
Area Wattage Allowance (AWA)	0.015 W/ft²	0.018 W/ft²	0.021 W/ft²	0.024 W/ft²
Linear Wattage Allowance (LWA)	0.13 W/lf	0.15 W/lf	0.20 W/lf	0.29 W/lf
Initial Wattage Allow ance (IWA)	150 W	200 W	250 W	320 W

Submeasure A: Lighting Power Allowances for General Hardscapes

Submeasure B: Lighting Zone Reclassification

Submeasure C: Multifamily Lighting Power Allowance Update

Today’s Objectives

The focus of today’s meeting includes:

1. **Review** Energy and Cost Calculations
2. **Receive Feedback** on Compliance and Enforcement Process
3. **Discuss** Updates to Code Language

Proposal Background

Code Change Proposal Summary

Submeasure	Type of Change	Software Updates Required	Sections of Code Updated	Compliance Documents Updated
Lighting Zone Reclassification	Determination of Outdoor Lighting Zones	N	Section 10-114	NRCC-LTO-01-E

Description of Changes

- Recommends revisions to lighting zone classifications
  - Refinement from last stakeholder meeting: LZs based on population instead of land-use categorization
  - New classifications based on population density categories from U.S. Census (rural, urban clusters, and urban areas)
- Results in shift of statewide square footage from LZ2 to LZ1

Lighting Zone Definitions

Aligning Statewide Default Location definitions with IES lighting zone definitions.

Lighting Zone	Ambient Illumination	Title 24 Statewide Default Location	IES Land Use Classifications	2010 U.S. Census Block Classification
LZ0	Very Low	Undeveloped areas of government designated parks	Wildlife areas, parks and preserves, and undeveloped rural areas.	N/A
LZ1	Low	Developed portion of government designated parks	**Rural and low-density residential areas:** Single or dual family residential areas, parks, and agricultural zone districts.	**Rural** Less than 2,500 people per square mile
LZ2	Moderate	Rural areas as defined by the 2010 U.S Census	**Light commercial business districts and high density or mixed-use residential districts:** Multifamily housing, mixed use residential neighborhoods, religious facilities, schools, and light commercial business districts or industrial zoning districts.	**Urban Clusters** 2,500 to 50,000 people per square mile
LZ3	Moderately High	Urban areas as defined by the 2010 U.S. Census	**Large cities' business district:** High intensity commercial corridors, entertainment centers, heavy industrial or manufacturing zone districts.	**Urban Areas** Over 50,000 people per square mile
LZ4	High	None.	**Not a default zone**	None.

Agencies can drop their LZs based on IES definitions independent of Title 24, Part 6

Benefits of Reduced Lighting Zones

Positive Impacts – Reduces pollution

- Cooperative Institute for Research in Environmental Sciences (CIRES) at the University of Colorado[a]
  - 2010 study of nitrate radical levels over Los Angeles
  - Light at night increases:
    - Smog (4% reduction in nitrate radical levels)
    - Ozone levels the next day (3.5% increase in nitrate oxide levels)
    - Acidity of water particles in the air (Nitrate oxide results in oxidation)

Source: https://en.m.wikipedia.org/wiki/Los_Angeles_County,_California

a. Stark, H., Brown, S., Wong, K. et al. City lights and urban air. Nature Geosci 4, 730–731 (2011)

Benefits of Reduced Lighting Zones *(continued)*

Positive Impacts:

- Reduces nighttime lighting impact to circadian rhythm
- Reduces impact to flora and fauna

Locations that have adopted lower lighting zone:

- Malibu, CA
- Chula Vista, CA
- Los Angeles County, CA

Right-of-way (ROW) is not regulated by Title 24, part 6
Roadway lighting is up to the cities' and counties' discretion

Code Change Summary

Results of Revisions to Lighting Zone Determination Language

Distribution of Lighting Zones Throughout California

Lighting Zone	Percent of Total Land Mass[a]	Percent of Outdoor Lighting Construction 2019 Code	Percent of Outdoor Lighting Construction Proposed 2022 Code
LZ0	9%	0%	0%
LZ1	1%	0.1%	5%
LZ2	85%	9.9%	5%
LZ3	5%	90%	90%
LZ4	0%	0%	0%

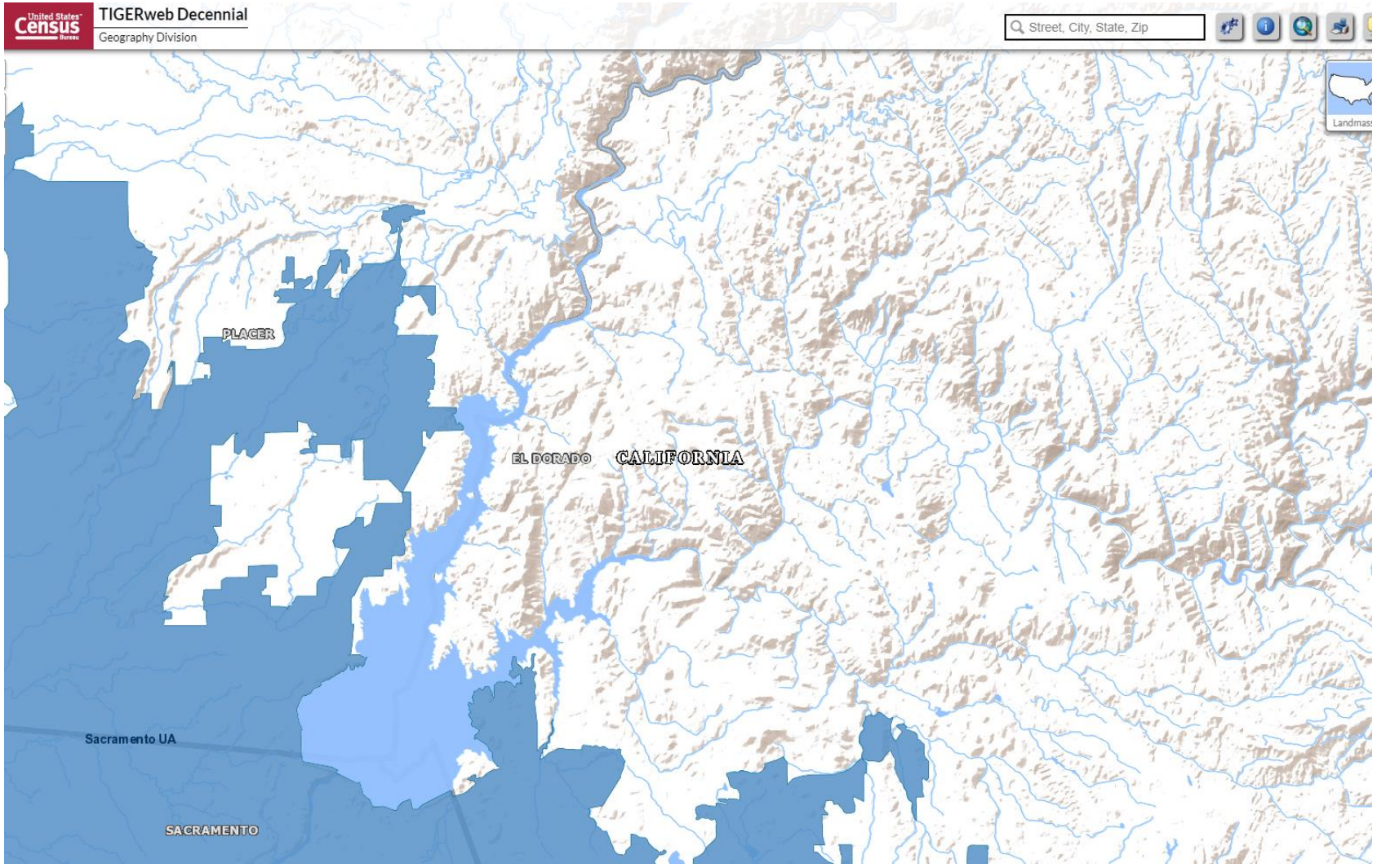
Shift from LZ2 to LZ1

Construction classified as LZ2 under 2019 code will be LZ1 in 2022 code

a. Source: 2010 U.S. Census

Code Change Summary

Example of Sacramento and Tahoe National Forest by Folsom Lake



Legend

- LZ3 - Urban Area
- LZ2 - Rural
- Folsom Lake

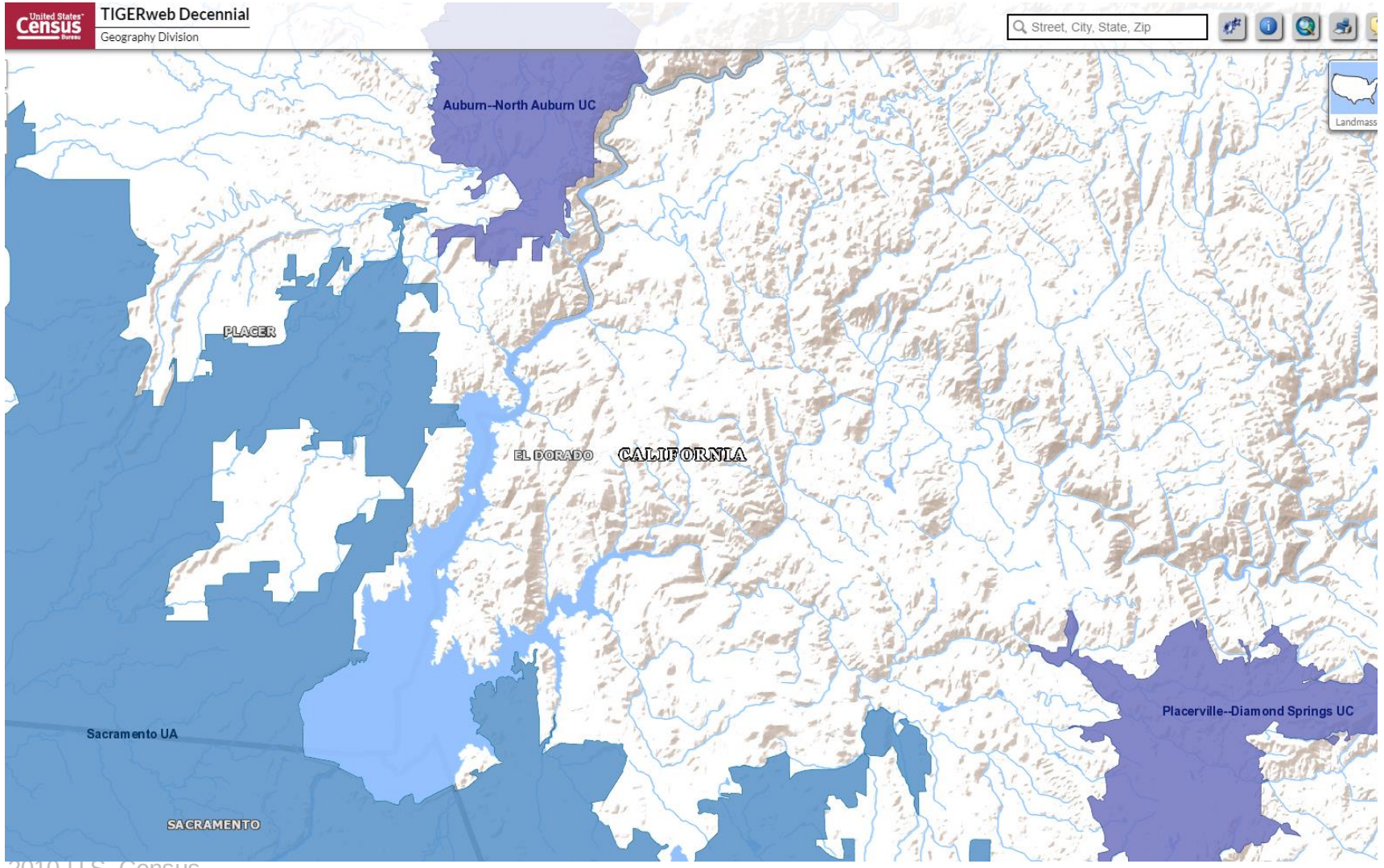
2019 Classification

Lighting Zone 2

2010 U.S. Census
Tigerweb.geo.census.gov/tigerweb2010

Code Change Summary

Example of Sacramento and Tahoe National Forest by Folsom Lake



2022 Legend

- LZ3 - Urban Area
- LZ2 - Urban Cluster
- LZ1 - Rural
- Folsom Lake

2022 Classification

Lighting Zone 2
Lighting Zone 1

2010 U.S. Census
Tigerweb.geo.census.gov/tigerweb2010

Summary of Recent Revisions to Proposal

- **Aiming to base LZs on land use:**
  - Have not located data source that meets criteria:
    - Maps with lighting zones based on land use characteristics
    - Reliable and accurate data
    - Accessible and understandable by local code officials
    - Does not require significant Energy Commission staff resources to maintain
  - Result: current recommendations are based on population density, not land use

The Statewide CASE Team is looking for data source suggestions that meet criteria listed above.

Energy and Cost Impacts

- Assumptions & Methodology
- Energy Impacts

Methodology for Energy Impacts Analysis

1. **Per Unit Savings:** calculate per unit power allowance difference between LZ1 and LZ2 of each outdoor lighting application

Calculated per unit savings for **General Hardscape** and each **Special Application**

2. **Per Unit Savings:** calculate annual electricity savings (kWh) based on hours of operation

3. **Statewide Savings:** multiply savings associated with moving from LZ2 to LZ1 by expected statewide square footage that will be classified as LZ1 instead of LZ2 as a result of the code change

Calculated statewide hardscape area based on Energy Commission's building construction forecast

Same methodology used for 2016 and 2019 code cycles

Methodology for Energy Impacts Analysis

Tools Used	Spreadsheet analysis for energy savings and costs
Lighting Zones Modeled	LZ1 and LZ2

Definition of Baseline and Proposed Conditions

Baseline Conditions

- 2019 LPAs
- **2019** Title 24 Part 6 LZ classifications
  - Rural: < 50,000 people per square mile
  - Urban Areas: > 50,000 people per square mile
- Hours of operation from 2016 and 2019 analyses

Proposed Conditions

- 2019 LPAs
- **2022** Title 24 Part 6 LZ classifications
  - Rural: < 2,500 people per square mile
  - Urban Clusters: 2,500 – 50,000 people per square mile
  - Urban Areas: > 50,000 people per square mile
- Same as baseline

How can we make LZ classifications based on land use and not population?

Energy Savings Results

Step 1: Calculate power allowance difference between LZ2 and LZ1

Example for **General Hardscape Lighting Zone Reclassification**

Type of Power Allowance	**Lighting Zone 1** 2019 LPAs	**Lighting Zone 2** 2019 LPAs Combined Asphalt/Concrete
Area Wattage Allowance (AWA)	0.018 W/ft^2	0.024 W/ft^2
Linear Wattage Allowance (LWA)	0.15 W/linear foot	0.285 W/linear foot
Initial Wattage Allowance (IWA)	180 W	250 W/ft^2
Effective Area Wattage Allowance (eAWA)	0.030 W/ft^2	0.044 W/ft^2

eAWA = LPA = (AWA x area of space + LWA x perimeter of space + IWA) ÷ area of space

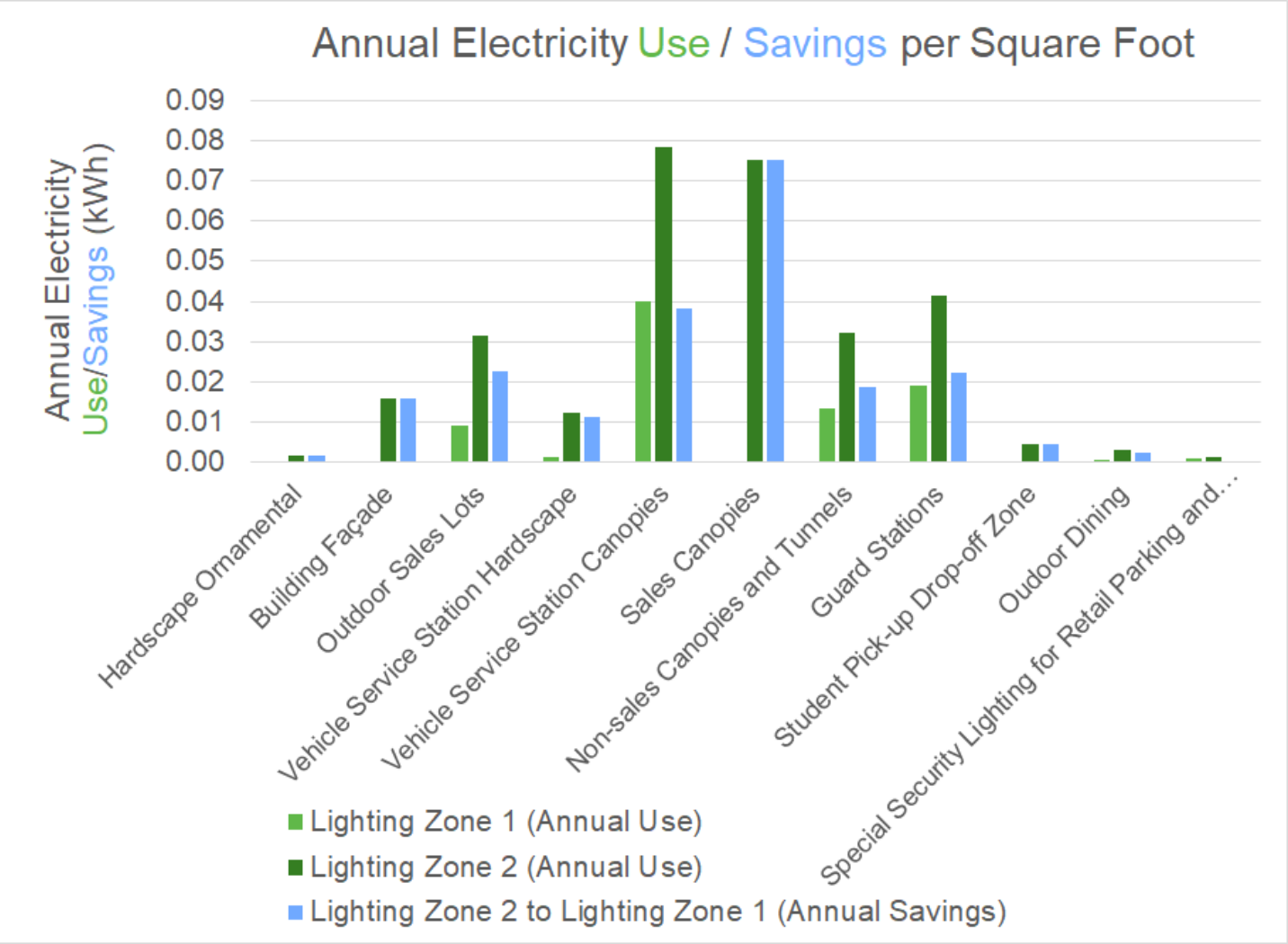
0.014 W/ft^2

Power Allowance Difference LZ2 to LZ1

0.044 W/ft^2 – 0.030 W/ft^2

Annual Energy Savings Results:

per Square Foot Specific Applications



0.002 to 0.076 kWh

Annual electricity savings per square foot of specific application lighting moved from LZ2 to LZ1

All Special Application energy savings will be presented in the Draft CASE Report

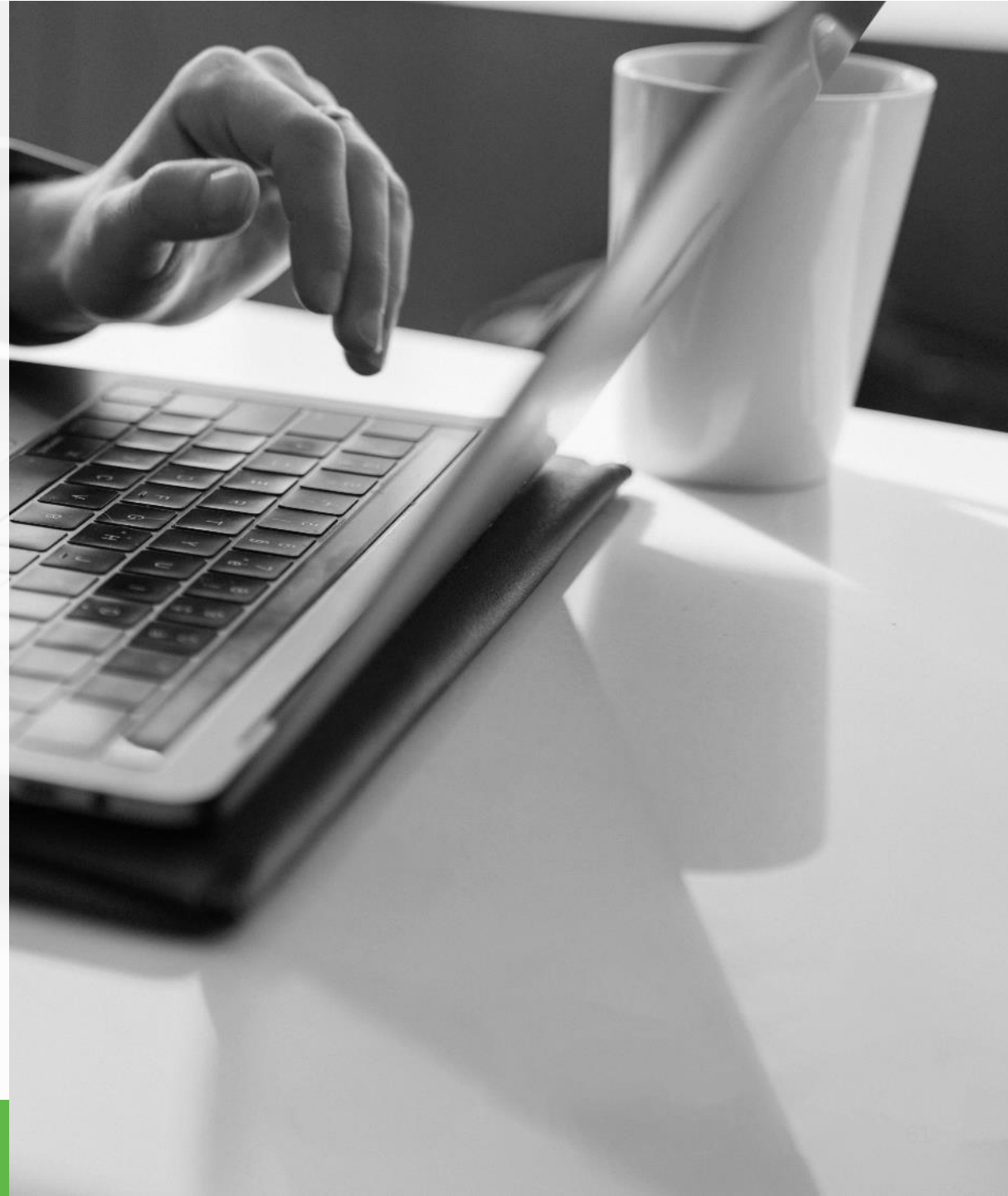
Assumptions for Statewide Savings Estimates

- **No outdoor construction estimates:** Converted forecast indoor construction floorspace (by building area) to General Hardscape (outdoor) area using assumptions about hardscape associated with each building type
  - **Building Floorspace to Outdoor Area Assumptions:** developed in 2016 code cycle, used again and refined in 2019 code cycle
  - **2022 code cycle:** will use same assumptions to develop statewide savings estimates
  - **Example:** 830 square feet of warehouse space equals 1 parking space (250 square feet of general hardscape)

Assumptions will be presented in Draft CASE Report. Feedback is appreciated.

Proposed Code Changes

- Draft Code Change Language



Draft Code Change Language Updates

- **Updated** draft code language for this submeasure is available in the **resources tab**
- U.S. Census - Urban Cluster population density added to lighting zone classification

Lighting Zone	Ambient Illumination	Statewide Default Location
LZ0	Very Low	Undeveloped areas of government designated parks, recreation areas, and wildlife preserves.
LZ1	Low	**Single or dual family residential areas, parks, and agricultural zone districts,** developed portion of government designated parks, recreation areas, and wildlife preserves. Those that are wholly contained within a higher lighting zone may be considered by the local government as part of that lighting zone.
LZ2	Moderate	**Multifamily housing, mixed use residential neighborhoods, religious facilities, schools, and light commercial business districts or industrial zoning districts, urban clusters** as defined by the 2010 US Census.
LZ3	Moderately High	**High intensity commercial corridors, entertainment centers, heavy industrial or manufacturing zone districts,** urban areas as defined by the 2010 US Census.
LZ4	High	None.

Classification updated to match IES Lighting Zone Definitions

Thank You

Questions?

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CALIFORNIA ENERGY CODES & STANDARDS
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Submeasure A: Lighting Zone Reclassification

Submeasure B: Lighting Power Allowances for General Hardscapes

Submeasure C: Multifamily Lighting Power Allowance Update

Today's Objectives

The focus of today's meeting includes:

1. **Review** Energy Calculations
2. **Discuss** Technical Feasibility
3. **Review** updates to Code Language
4. **Collect** Feedback on Code Language and Other Topics

Proposal Background

2022 Focus on Multifamily

Reorganize requirements into a standalone chapter of Title 24, Part 6

Increase uniformity across low-rise and high-rise requirements and other sections of the building code

Improve modeling accuracy through software improvements and proposed prototypes

- **New Multifamily Chapters**
  - 160 Mandatory Features and Devices
  - 170 Performance and Prescriptive Compliance Approaches
  - 180 Additions and Alterations
- **Include common area spaces**
- **Refer to:**
  - Section 110 for mandatory measures
  - Sections 120, 130, and 140 for nonresidential spaces not exclusive to residents

2022 Multifamily Outdoor Lighting Code Design Approach

- Create new multifamily sections by using existing nonresidential chapters for outdoor lighting
  - 140.7 Outdoor Lighting
  - 130.2 Outdoor Lighting Controls
- Add specific details for multifamily projects, remove items unnecessary or antithetical to multifamily projects.

Context and History

Shortcomings of defining Outdoor Lighting as either nonresidential (NR) or residential (Res):

- “Gray Area” projects
- Multifamily projects are treated as NR – high LPA and light levels are possible
- Mixed-use developments – Very high LPA and light levels are possible

Code Change Proposal Summary

Submeasure	Type of Change	Software Updates Required	Sections of Code Updated	Compliance Documents Updated
Multifamily Outdoor Lighting Power Allowance	Mandatory and Prescriptive	N	Section 130.2 & 140.7 (Revised and renumbered for new MF Sections)	2019-NRCC-LTO-E

Description of Changes

- Create new sections for multifamily outdoor lighting and controls
- Slight modifications to scope to abandon glare control restrictions

Why are we proposing this measure?

Energy savings from:

- Reduced general hardscape LPA – reflects LED technology advancement
- Elimination of certain LPA allowances – focused on high-traffic and outdoor retail conditions
- Reduced annual HOU for lighting controls – updated IES recommendations for night setback

  (annual HOU - annual full time equivalent Hours of Use)

Improved outdoor lighting environment for multifamily residents:

- Lower allowances/levels for residential areas – primarily mixed-use conditions
- Controls for late night unoccupied areas – late-night setback adjustments

Simplified code compliance process:

- Elimination of “perimeter” allowance (Linear Wattage Allowance) from calculations

Energy and Cost Impacts

- Assumptions & Methodology
- Energy Impacts
- Cost Impacts
  - Incremental costs
  - Maintenance costs
  - Energy cost savings
- Cost-effectiveness

Methodology for Energy Impacts Analysis

Outdoor lighting per dwelling unit was calculated by equating typical square footage of hardscape to each building prototype from observed project statistics.

Tools Used	• AGI32 for lighting calculations • Spreadsheet analysis for energy, costs, and site characteristics
Building Prototypes Used	Low-Rise Garden - (8 units, 2 floors, 7,320 SF) Loaded Corridor - (23 units, 3 floors, 39,372 SF) Mid-Rise Mixed Use - (88 units, 5 floors total, 113,700 SF) High-Rise Mixed Use - (117 units, 10 floors total, 125,400 SF)
Climate Zones Modeled	N/A: Outdoor lighting is not Climate Zone dependent for energy use

Assumptions for Energy Impacts Analysis

- Properties use the maximum LPA the code allows
- Title 24-2019 nonresidential code applies as the baseline
- Code LPA values are based on IES recommended practice light levels and determine the approximate minimum LPA assigned (with allowance for site and fixture variables)
- Building construction forecasts from the Energy Commission determine the number of dwelling units per year per climate zone (CZ).
- Energy savings and TDV calculations are made by both CZ and lighting zone (LZ)

Building Prototypes Model Assumptions

Based on data collected from approximately 24 projects that participated in the California Multifamily New Homes (CMFNH) program, the following square footage of General Hardscape is being assigned to each building prototype dwelling unit to model energy impacts:

Prototype	General Hardscape Area per Dwelling Unit (Square Feet)
Low-Rise Garden	1450
Mid-Rise Loaded Corridor	375
Mid-Rise Mixed Use	450
High-Rise Mixed Use	250

Definition of Baseline and Proposed Conditions

Baseline Conditions

- Title 24 Section 130.2 and 140.7 applies (nonresidential requirements)
- Dusk to dawn operation with setbacks for activity or late-night setback
- High outdoor activity in early evening that tapers to low by 1 AM

Proposed Conditions

Same assumptions as baseline, but:

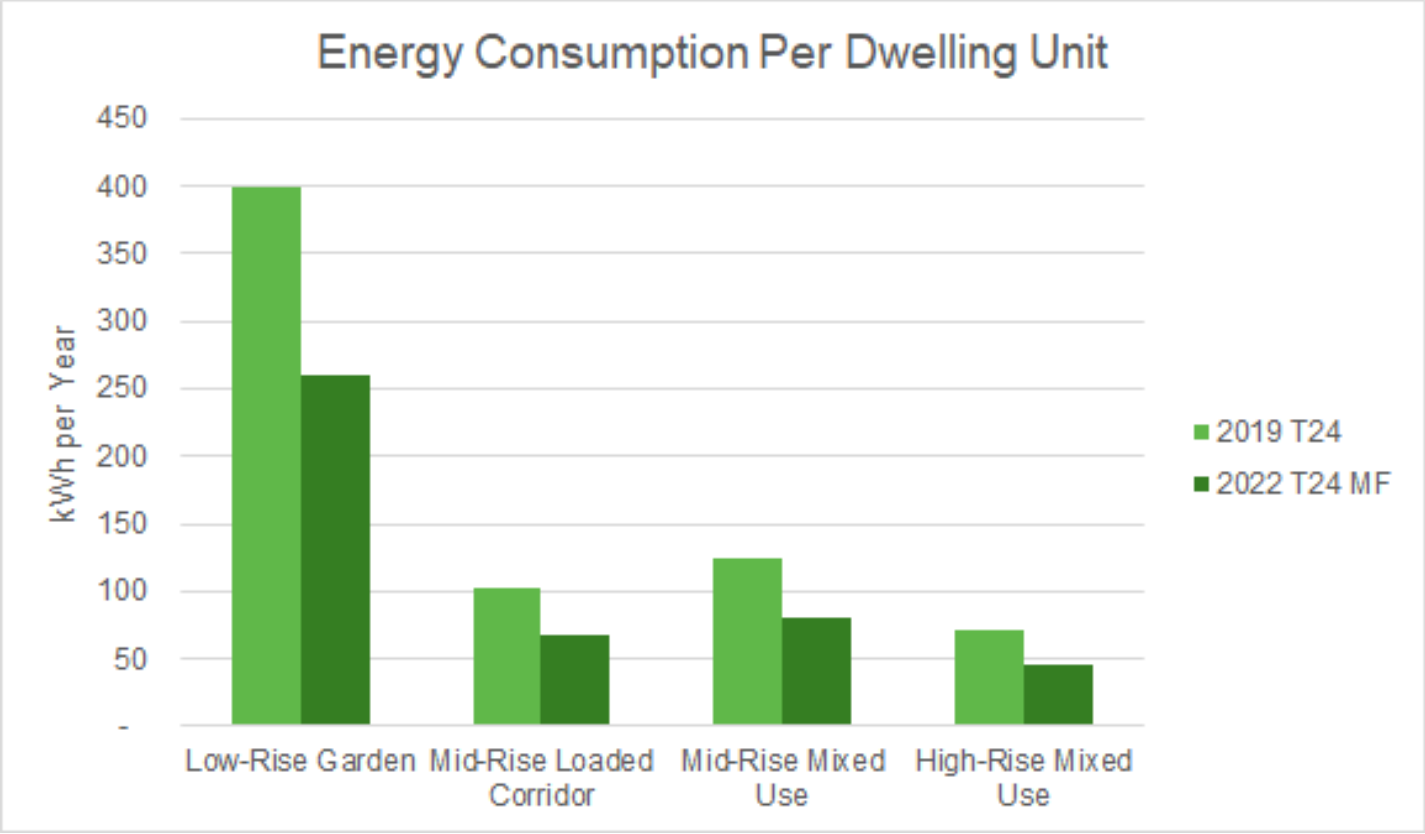
- Change in LPA values
- Change in setback level

2023 Construction Forecast: MF New Construction

Building Type	Total Statewide New Construction Permitted and Impacted in 2023 (Dwelling Units)
Low-Rise Garden	2,080
Mid-Rise Loaded Corridor	17,150
Mid-Rise Mixed Use	30,140
High-Rise Mixed Use	2,060

- Total multifamily dwelling units in new construction for 2023 across all four lighting zones and all sixteen climate zones
- Percent of statewide new construction impacted by proposal: 100%

Per Dwelling Unit Energy Savings – kWh per Year



Prototypical Building	Per Dwelling Unit Energy Savings (kWh per Year)
Low-Rise Garden	140
Mid-Rise Loaded Corridor	36
Mid-Rise Mixed Use	43
High-Rise Mixed Use	25

Statewide Annual Energy Savings – MWh per Year

Prototypical Building	Statewide Annual Energy Savings (MWh per Year)
Low-Rise Garden	291
Mid-Rise Loaded Corridor	620
Mid-Rise Mixed Use	1,308
High-Rise Mixed Use	51

2,270 MWh

Total statewide annual savings

Code Language

Draft Code Change Language – Table 140.7-A

TABLE 140.7-A GENERAL HARDSCAPE MULTIFAMILY LIGHTING POWER ALLOWANCE

Type of Power Allowance	Lighting Zone 0[3]	Lighting Zone 1[3]	Lighting Zone 2[3]		Lighting Zone 3[3]		Lighting Zone 4[3]
	~~Asphalt/Concrete~~	~~Asphalt/Concrete~~	~~Asphalt~~	~~Concrete[2]~~	~~Asphalt~~	~~Concrete[2]~~	~~Asphalt/Concrete~~
Area Wattage Allowance (AWA)	No allowance[1]	0.026 ~~0.018~~ W/ft^2	0.032 ~~0.023~~ W/ft^2	~~0.025 W/ft^2~~	0.042 ~~0.025~~ W/ft^2	~~0.03 W/ft^2~~	0.06 ~~0.03~~ W/ft^2
~~Linear Wattage Allowance (LWA)~~		~~0.15 W/lf~~	~~0.17 W/lf~~	~~0.4 W/lf~~	~~0.25 W/lf~~	~~0.4 W/lf~~	~~0.35 W/lf~~
Initial Wattage Allowance (IWA)		300 ~~180~~ W	350 ~~250~~ W	~~250 W~~	400 ~~350~~ W	~~350 W~~	600 ~~400~~ W

[1]Continuous lighting is explicitly prohibited in Lighting Zone 0. A single luminaire of 15 Watts or less may be installed at an entrance to a parking area, trail head, fee payment kiosk, outhouse, or toilet facility, as required to provide safe navigation of the site infrastructure. Luminaires installed shall meet the maximum zonal lumen limits as specified in Section 130.2(b).

~~[2]Where greater than 50% of the paved surface of a parking lot is finished with concrete. This does not extend beyond the parking lot, and does not include any other General Hardscape areas.~~

[3]Narrow band spectrum light sources with a dominant peak wavelength greater than 580 nm – as mandated by local, state, or federal agencies to minimize the impact on local, active professional astronomy or nocturnal habitat of specific local fauna – shall be allowed a 2.0 lighting power allowance multiplier.

Draft Code Change Language – Table 140.7-B

Remove the following additional allowances from the table:

- Drive-up windows
- Vehicle service station uncovered fuel dispenser
- Outdoor sales frontage
- Outdoor sales lots
- Vehicle service station hardscape
- Vehicle service station canopies
- Sales canopies
- Guard stations

Draft Code Change Language – Table 140.7-B

Modify the following additional allowances in the table:

- Remove "Police Stations, Healthcare Facilities, Fire Stations, and Emergency Vehicle Facilities" from the Primary Entrances additional allowance
- Reduce the Hardscape Ornamental Lighting allowance to apply to luminaires that are less than 30 watts (down from 100 watts)
- Add a restriction to the Building Façade allowance that the allowance shall not be applied to any façade surface area within 20' of a residence bedroom window
- Remove the term "Non-Sales" from the Canopies and Tunnels allowance so it can apply to any of these, regardless of application.

Draft Code Change Language – Table 140.7-B

TABLE 140.7-B ADDITIONAL MULTIFAMILY LIGHTING POWER ALLOWANCE FOR SPECIFIC APPLICATIONS

All area and distance measurements in plan view unless otherwise noted.

Lighting Application	Lighting Zone 0	Lighting Zone 1	Lighting Zone 2	Lighting Zone 3	Lighting Zone 4
WATTAGE ALLOWANCE PER APPLICATION. Use all that apply as appropriate.					
Building Entrances or Exits. Allowance per door. Luminaires qualifying for this allowance shall be within 20 feet of the door.	Not applicable	9 watts	15 watts	19 watts	21 watts
Primary Entrances to Senior Care Facilities, ~~**Police Stations, Healthcare Facilities, Fire Stations, and Emergency Vehicle Facilities**~~**.** Allowance per primary entrance(s) only. Primary entrances shall provide access for the general public and shall not be used exclusively for staff or service personnel. This allowance shall be in addition to the building entrance or exit allowance above. Luminaires qualifying for this allowance shall be within 100 feet of the primary entrance.	Not applicable	20 watts	40 watts	57 watts	60 watts
~~**Drive Up Windows.** Allowance per customer service location. Luminaires qualifying for this allowance shall be within 2 mounting heights of the sill of the window.~~	~~Not applicable~~	~~16 watts~~	~~30 watts~~	~~50 watts~~	~~75 watts~~
~~**Vehicle Service Station Uncovered Fuel Dispenser.** Allowance per fueling dispenser. Luminaires qualifying for this allowance shall be within 2 mounting heights of the dispenser.~~	~~Not applicable~~	~~55 watts~~	~~77 watts~~	~~81 watts~~	~~135 watts~~
ATM Machine Lighting. Allowance per ATM machine. Luminaires qualifying for this allowance shall be within 50 feet of the dispenser.	Not applicable	100 watts for first ATM machine, 35 watts for each additional ATM machine.			
~~**WATTAGE ALLOWANCE PER UNIT LENGTH (w/linear ft). May be used for one or two frontage side(s) per site.**~~					
~~**Outdoor Sales Frontage.** Allowance for frontage immediately adjacent to the principal viewing location(s) and unobstructed for its viewing length. A corner sales lot may include two adjacent sides provided that a different principal viewing location exists for each side. Luminaires qualifying for this allowance shall be located between the principal viewing location and the frontage outdoor sales area.~~	~~Not applicable~~	~~No Allowance~~	~~11 W/linear ft~~	~~19 W/linear ft~~	~~25 W/linear ft~~

Draft Code Change Language – Table 140.7-B

	WATTAGE ALLOWANCE PER SPECIFIC AREA (W/ft²). Use as appropriate provided that none of the following specific applications shall be used for the same area.				
Building Facades. Only areas of building façade that are illuminated shall qualify for this allowance. Luminaires qualifying for this allowance shall be aimed at the façade and shall be capable of illuminating it without obstruction or interference by permanent building features or other objects. This allowance shall not be applied to portions of the building facades within 20' of residence bedroom windows.	Not applicable	No Allowance	0.100 W/ft²	0.170 W/ft²	0.225 W/ft²
~~**Outdoor Sales Lots.** Allowance for uncovered sales lots used exclusively for the display of vehicles or other merchandise for sale. Driveways, parking lots or other non sales areas shall be considered hardscape areas even if these areas are completely surrounded by sales lot on all sides. Luminaires qualifying for this allowance shall be within 5 mounting heights of the sales lot area.~~	~~Not applicable~~	~~0.060 W/ft²~~	~~0.210 W/ft²~~	~~0.280 W/ft²~~	~~0.485 W/ft²~~
~~**Vehicle Service Station Hardscape.** Allowance for the total illuminated hardscape area less area of buildings, under canopies, off property, or obstructed by signs or structures. Luminaires qualifying for this allowance shall be illuminating the hardscape area and shall not be within a building, below a canopy, beyond property lines, or obstructed by a sign or other structure.~~	~~Not applicable~~	~~0.006 W/ft²~~	~~0.068 W/ft²~~	~~0.138 W/ft²~~	~~0.200 W/ft²~~
~~**Vehicle Service Station Canopies.** Allowance for the total area within the drip line of the canopy. Luminaires qualifying for this allowance shall be located under the canopy.~~	~~Not applicable~~	~~0.220 W/ft²~~	~~0.430 W/ft²~~	~~0.580 W/ft²~~	~~1.010 W/ft²~~
~~**Sales Canopies.** Allowance for the total area within the drip line of the canopy. Luminaires qualifying for this allowance shall be located under the canopy.~~	~~Not applicable~~	~~No Allowance~~	~~0.470 W/ft²~~	~~0.622 W/ft²~~	~~0.740 W/ft²~~
~~Non sales~~ **Canopies and Tunnels.** Allowance for the total area within the drip line of the canopy or inside the tunnel. Luminaires qualifying for this allowance shall be located under the canopy or tunnel.	Not applicable	0.057 W/ft²	0.137 W/ft²	0.270 W/ft²	0.370 W/ft²
~~**Guard Stations.** Allowance up to 1,000 square feet per vehicle lane. Guard stations provide access to secure areas controlled by security personnel who stop and may inspect vehicles and vehicle occupants, including identification, documentation, vehicle license plates, and vehicle contents. Qualifying luminaires shall be within 2 mounting heights of a vehicle lane or the guardhouse.~~	~~Not applicable~~	~~0.081 W/ft²~~	~~0.176 W/ft²~~	~~0.325 W/ft²~~	~~0.425 W/ft²~~

Draft Code Change Language – Table 140.7-B

CONTINUED: TABLE 140.7-B ADDITIONAL LIGHTING POWER ALLOWANCE FOR SPECIFIC APPLICATIONS

All area and distance measurements in plan view unless otherwise noted.

Lighting Application	Lighting Zone 0	Lighting Zone 1	Lighting Zone 2	Lighting Zone 3	Lighting Zone 4
Student Pick-up/Drop-off zone. Allowance for the area of the student pick-up/drop-off zone, with or without canopy, for preschool through 12th grade school campuses. A student pick-up/drop off zone is a curbside, controlled traffic area on a school campus where students are picked-up and dropped off from vehicles. The allowed area shall be the smaller of the actual width or 25 feet, times the smaller of the actual length or 250 feet. Qualifying luminaires shall be within 2 mounting heights of the student pick-up/drop-off zone.	Not applicable	No Allowance	0.056 W/ft²	0.200 W/ft²	No Allowance
Outdoor Dining. Allowance for the total illuminated hardscape of outdoor dining. Outdoor dining areas are hardscape areas used to serve and consume food and beverages. Qualifying luminaires shall be within 2 mounting heights of the hardscape area of outdoor dining.	Not applicable	0.004 W/ft²	0.030 W/ft²	0.050 W/ft²	0.075 W/ft²
Special Security Lighting for Retail Parking and Pedestrian Hardscape. This additional allowance is for illuminated retail parking and pedestrian hardscape identified as having special security needs. This allowance shall be in addition to the building entrance or exit allowance.	Not applicable	0.004 W/ft²	0.005 W/ft²	0.010 W/ft²	No Allowance

Thank You

Questions?

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CALIFORNIA ENERGY CODES & STANDARDS

A STATEWIDE UTILITY PROGRAM

2022 CALIFORNIA ENERGY CODE (TITLE 24, PART 6)

Daylighting

Codes and Standards Enhancement (CASE) Proposal

Nonresidential | Daylighting

Jasmine Shepard, *Energy Solutions*

March 3, 2020

CALIFORNIA ENERGY CODES & STANDARDS

A STATEWIDE UTILITY PROGRAM

Today's Objectives

The focus of today's meeting includes:

1. **Update** on proposal changes
2. **Address** Cost Effectiveness
3. **Review** Energy Calculations
4. **Review** Compliance and Enforcement
5. **Review** Proposed Code Language

Proposal Background

Code Change Proposal Summary

Submeasure	Type of Change	Software Updates Required	Sections of Code Updated	Compliance Documents Updated
Daylight Dimming to 10%	Mandatory	Y	130.1(d)	NA 7.6 and NA 7.8

Description of Changes

- Require dimming to 10 percent of lighting
- Move requirements for automatic daylighting controls in the secondary sidelit daylight zones from prescriptive to mandatory (addresses compliance challenges)

Updates to Proposal

- **Dim to OFF now Dim to 10%**
  - Table 130.1-A Aligns with current LED requirement multi-level Lighting Controls and Uniformity Requirements (Continuous Dimming 10-100 percent)
    - The Statewide CASE Team is still searching for data on dim to OFF. Specifically, data on occupant feedback on dim to OFF.
  - Power Allowance Factor (PAF) for Dim to OFF to remain
- No longer pursuing revisions to Power Adjustment Factor(PAF) for exterior shading thermal breaks

Poll

Based on your experience, do you anticipate a difference in feasibility in dimming to 10% versus dimming to 35%(current standard)?

A. Dimming to 10% will be easier than Dimming to 35%
B. Dimming to 10% will be about the same as Dimming to 35%
C. Dimming to 10% will be harder than Dimming to 35%
D. Unsure

Poll

Based on your experience, do you anticipate a difference an feasibility in Dimming to 10% versus Dimming to OFF?

A. Dimming to 10% will be easier than Dimming to OFF
B. Dimming to 10% will be about the same as Dimming to OFF
C. Dimming to 10% will be harder than Dimming to OFF
D. Unsure

Code Change Proposal: Additional Resources

First-Utility Sponsored Meeting

The Statewide CASE Team held its first utility-sponsored stakeholder meeting for this topic on **September 5, 2019.**

Resources on Title24stakeholders.com

Presentation slides and **Daylighting** documents available that cover the following:

- ✓ Measure Background
- ✓ Market Overview & Analysis
- ✓ Technical Feasibility
- ✓ Compliance & Enforcement
- ✓ Draft Code Language

*Previous Documents based on Daylight Dimming to OFF
Also available in the **resources tab in today's presentation.**

Energy and Cost Impacts

- Assumptions & Methodology
- Energy Impacts
- Cost Impacts
  - Incremental costs
  - Maintenance costs
  - Energy cost savings
- Cost-effectiveness

Methodology for Energy Impacts Analysis

Tools Used	CBECC-Com 2022 Research version EnergyPlus 9.0.1 and
Building Prototypes Used	Small Office, Non-refrigerated Warehouses, Medium Office, Large Office, Large School
Climate Zones Modeled	1-16

Methodology for Energy Impacts Analysis

- **Utilize energy** modeling software compare daylight dimming continuously to 35% and 10% in required daylit areas.
- **15-year** time-dependent valuation (TDV) analysis

Definition of Baseline and Proposed Conditions

Baseline Conditions

- Office, School, and Warehouse Prototypes
  - LPD 2019 Area Category
  - Daylight dimming for general lighting in skylit daylit zones and primary sidelit daylit zones
  - Daylight dimming to 35%

Proposed Conditions

- Office, School, and Warehouse Prototypes
  - LPD 2019 Area Category
  - Daylight dimming for general lighting in skylit daylit zones and primary sidelit daylit zones
  - Daylight dimming to 10%

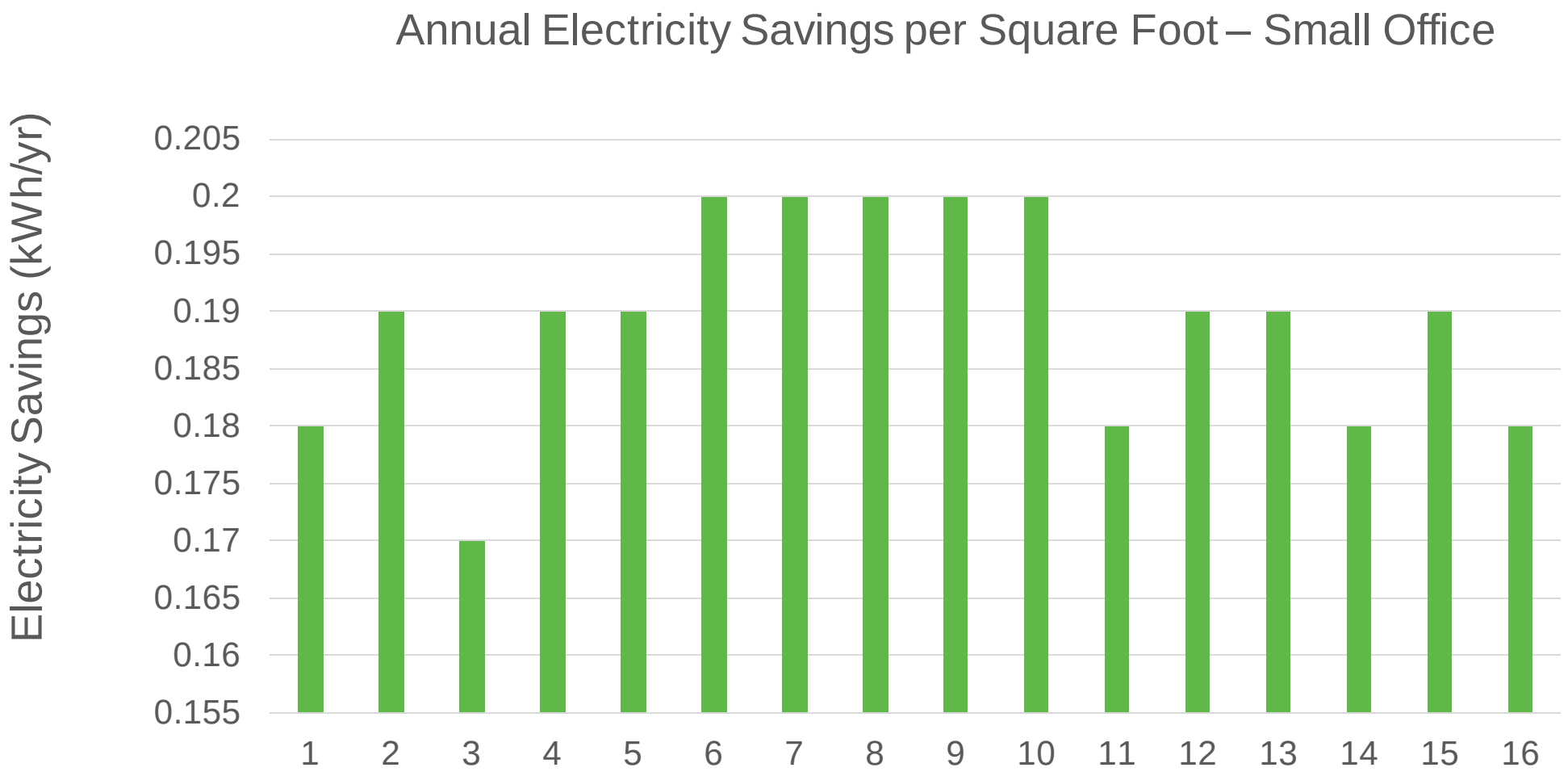
Preliminary Energy Savings Estimates Per Square Foot of Daylit Area

Daylight Dimming to 10% - Weighted Average for All Climate Zones

Building Prototype	Annual Electricity Savings (kWh/ft^2/yr)	Peak Electricity Demand Reductions (W/ft^2)	Annual TDV Energy Savings (TDV kBtu/yr)
Office Medium	0.218	0.012	9.83
Office Small	0.191	0.009	24.70
Office Large	0.560	0.039	14.50
School Small	0.257	0.025	1.96
Warehouse	2.720	0.127	48.60

Energy Savings per Square Foot of Daylit Area

Small Office in all Climate Zones Dimming to 10%*



*Subject to change

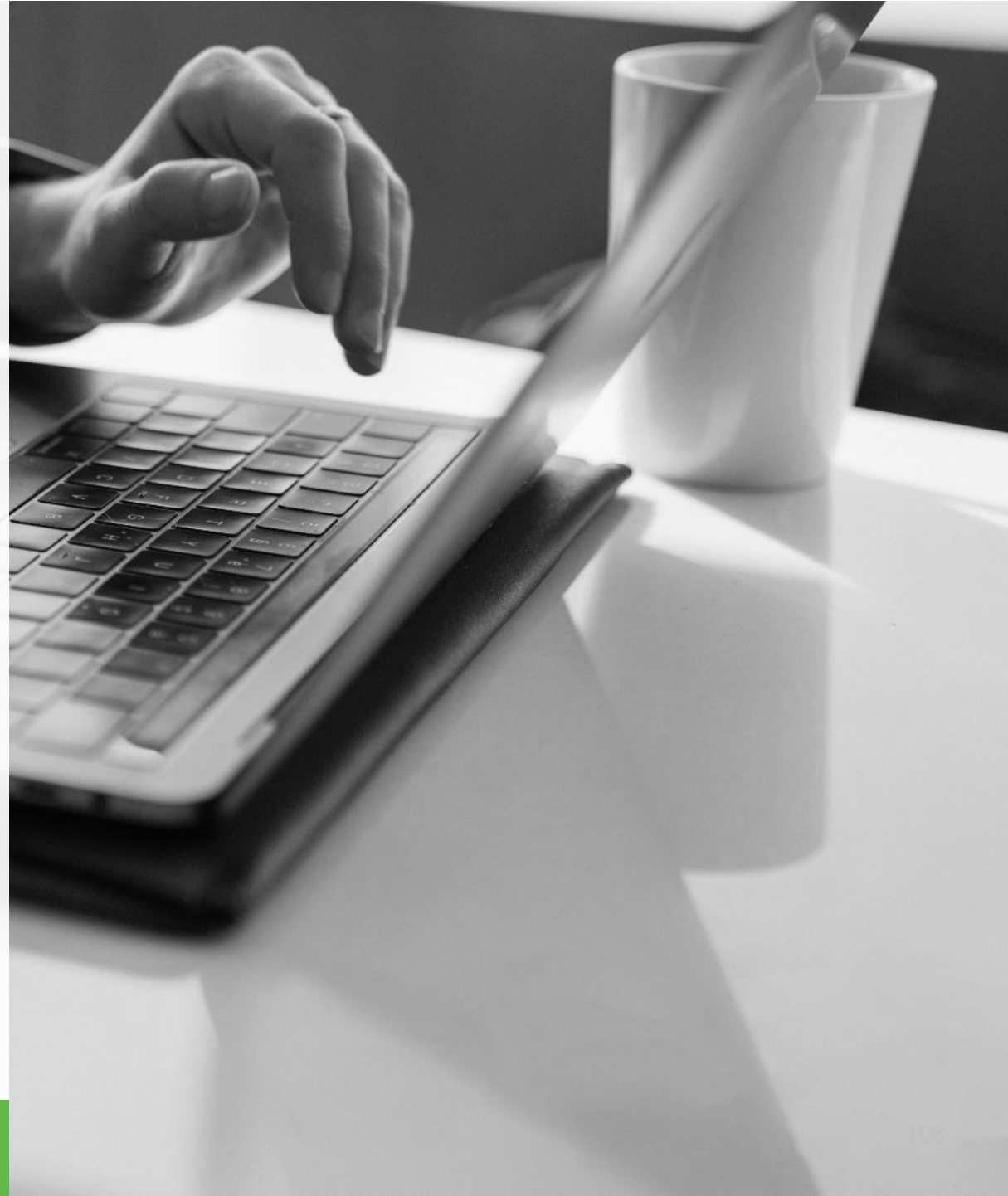
Cost Effectiveness Incremental Cost Information

- No additional or more advanced equipment required to dim to 10% = **No incremental costs in materials or labor**
- Assuming no incremental costs for a Acceptance Test Technician or Commissioning Professional.

The Statewide CASE Team appreciates feedback on whether dimming to 10% will result in increased costs at acceptance testing or commissioning phase.

Proposed Code Changes

- Draft Code Change Language
- Proposed Software Updates



Draft Code Change Language

- **Updated** draft code language for this submeasure is available in the **resources tab.**

Software Updates

- CBECC-Com will need to updated to edit the dimming and power fraction
  - Default needs to be 0.10 (currently 0.20)
    - *Default assumption for 2019 should be consistent with prescriptive requirement (0.35)*
  - Have the ability to be adjusted lower
  - Keep continuous dimming to off
  - Still conducting stakeholder outreach on keeping daylight stepped dimming

Thank You

Questions?

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CALIFORNIA ENERGY CODES & STANDARDS

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2022 CALIFORNIA ENERGY CODE (TITLE 24, PART 6)

Demand Responsive Lighting

Codes and Standards Enhancement (CASE) Proposal

Nonresidential | Grid Integration

David Jagger, *Energy Solutions*

March 3, 2020

CALIFORNIA ENERGY CODES & STANDARDS

A STATEWIDE UTILITY PROGRAM

Agenda

Today's Objectives

The focus of today's meeting includes:

1. **Review** 0.5 Watts per Square Foot Proposal to Link with the Multi-Level Lighting Exemption of the Same
2. **Review** Energy Savings & Cost Methodology
3. **Review** Cost-Effectiveness Threshold Calculations
4. **Review** Acceptance Test Amendments

Proposal Background

Code Change Proposal Summary

Submeasure	Type of Change	Software Updates Required	Sections of Code Updated	Compliance Documents Updated
Tie the 0.5 W/ft^2 exemption threshold to multi-level exemption of same.	Mandatory	N	Section 110.12	N/A
Replace 10,000 ft^2 threshold with cost-effective total designed wattage.	Mandatory	N	Section 110.12 & 140.6	N/A
Remove the 50% illuminance threshold in the acceptance test and introduce a third, full building acceptance test verification method.	Mandatory	N	Reference Appendices, NA7.6.3	N/A

Changes from 1st Stakeholder Meeting

1. Demand responsive outdoor lighting is no longer being considered.
2. Keeping the uniformity requirement, 130.1-A, in place.
3. No longer re-evaluating the 0.5 W/ft^2 exemption threshold. Instead linking this exception to multi-level exemption of the same.

Code Change Proposal: Additional Resources

First-Utility Sponsored Meeting

The Statewide CASE Team held its first utility-sponsored stakeholder meeting for this topic on **September 10, 2019.**

Resources on Title24stakeholders.com

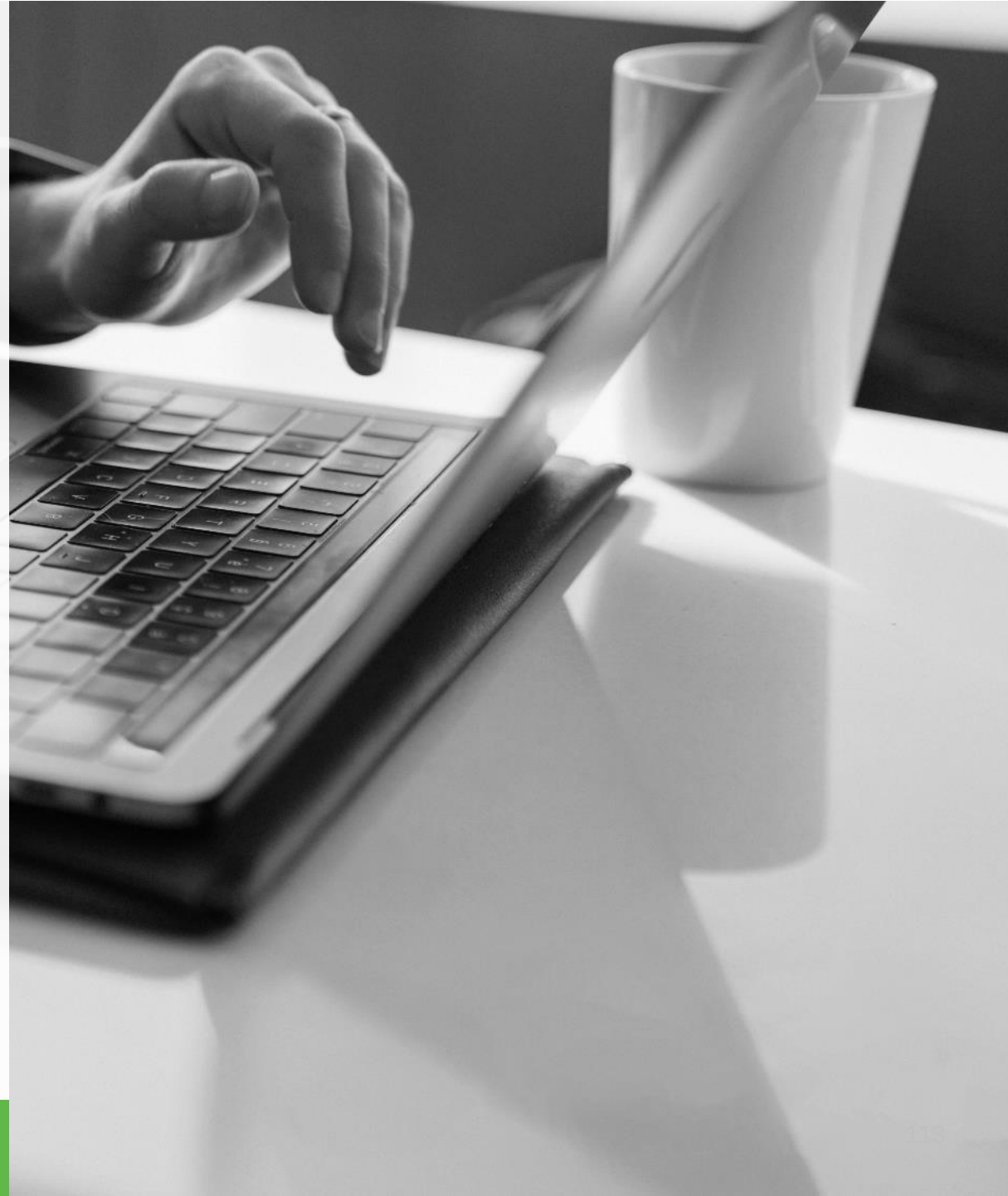
Presentation slides and **Submeasure summary** documents available that cover the following:

- ✓ Measure Background
- ✓ Market Overview & Analysis
- ✓ Technical Feasibility
- ✓ Compliance & Enforcement
- ✓ Draft Code Language

Also available in the **resources tab in today's presentation.**

Lighting Power Density Exemption

- Existing 0.5 Watts/ft^2 Exemption



0.5 Watts Per Square Foot Exemption

Intention: Achieve the same result while setting up future revisions by linking to cost-prohibitive feature

Current Standards Language, 110.12(c)

- Spaces with a lighting power density (LPD) of 0.5 W/ft^2 or less are not required to install DR controls do not count towards the 10,000 ft^2 threshold.

Proposed Standards Language, 110.12(c)

- Spaces with a LPD less than or equal to that specified for multilevel lighting controls [Section 130.1(b)] are not required to install DR controls do not count towards the designed wattage threshold.

Energy and Cost Impacts

- Methodology
  - Energy Impacts Analysis
  - Incremental Cost
- Cost-effectiveness

Methodology for Energy Impacts Analysis

Calculate the available lighting power of prototypes and calculate savings during demand responsive hours.

Tools Used	Spreadsheet analysis.
Building Prototypes Used	**12 Total**: Office small, office medium, office large, strip mall, stand-alone retail, retail large, retail mixed-use, primary school, secondary school, warehouse (non-refrigerated), quick service restaurant, and small hotel. Paired with Database for Energy Efficiency Resources (DEER) space by space allocation.
Climate Zones Modeled	Impacts were assumed to be the same across climate zones.

Energy Impacts Analysis Methodology

Office Small Prototype
+
DEER Space Allocation
+
Area Category Installed LPD

Small Office Prototype

Activity Area	Area Fraction	ASHRAE Model ft^2	Area Category Installed LPD (W/ft^2)
Break	4%	203	0.69
CompRoomData	1%	71	0.43
Conference	6%	313	0.83
CopyRoom	1%	55	0.36
Hall	6%	352	0.43
LobbyWaiting	6%	324	0.83
MechElecRoom	2%	90	0.43
OfficeOpen	36%	1,961	0.58
OfficeSmall	25%	1,357	0.65
RestRoom	4%	235	0.75
StorageSmlCond	10%	539	0.33
Total:	100%	5,500	

Source: PNNL_Scorecard_Prototypes_Office_small, https://www.energycodes.gov/development/commercial/prototype_models
Source: 2016 Energy Standards Lighting Fact Sheet: Nonresidential Daylighting and Daylighting Controls 2016, https://ww2.energy.ca.gov/title24/orc/lighting/2016_lighting.html

Energy Impacts Analysis Methodology *(continued)*

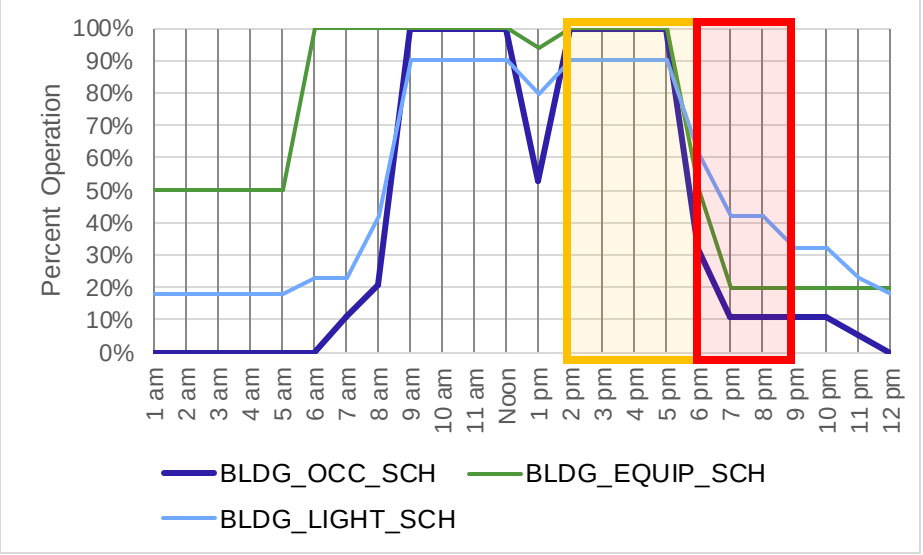
Office Small Prototype
+
DEER Space Allocation
+
Area Category Installed LPD

Facility Open
Hours: 2-6 PM
Average Light Levels: 83%

Facility Closed
Hours: 6-9 PM
Average Light Levels: 39%

all Office Prototype

Activity Area	Area Fraction	ASHRAE Model ft^2	Area Category Installed LPD (W/ft^2)
Break	4%	203	0.69
CompRoomData	1%	71	0.43
Conference	6%	313	0.83
CopyRoom	1%	55	0.36
Hall	6%	352	0.43
LobbyWaiting	6%	324	0.83
MechElecRoom	2%	90	0.43
OfficeOpen	36%	1,961	0.58
OfficeSmall	25%	1,357	0.65
RestRoom	4%	235	0.75
StorageSmlCond	10%	539	0.33
Total:	100%	5,500	



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Energy Impacts Analysis Methodology *(continued)*

Office Small Prototype
+
DEER Space Allocation
+
Area Category Installed LPD

Facility Open
Hours: 2-6 PM
Average Light Levels: 83%

Daylighting
Space that Lies Within Primary/ Secondary Daylight or Skylit Zones: 69%
Average Sunset Across Climate Zones: 6:45 PM

Facility Closed
Hours: 6-9 PM
Average Light Levels: 39%

Daylighting
Fraction of Building in Primary/ Secondary Daylight or Skylit Zones: 69%
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all Office Prototype

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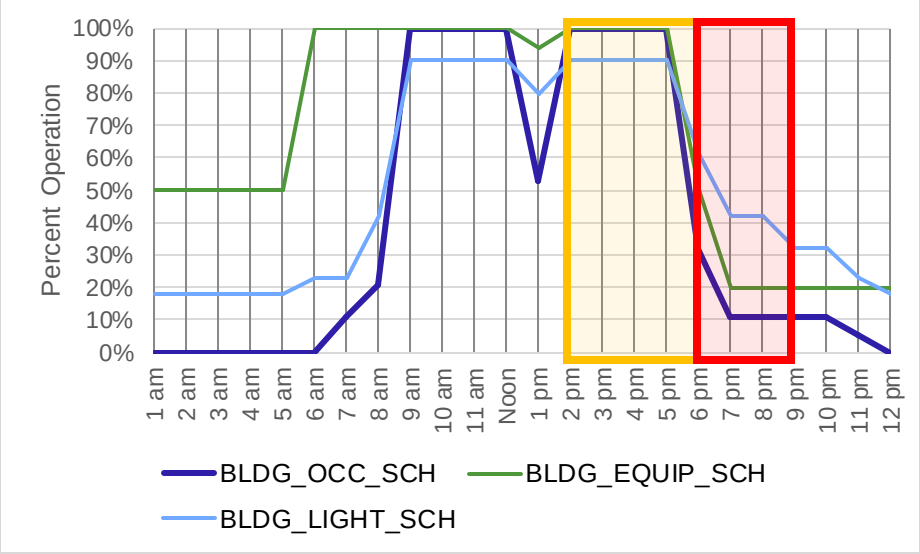

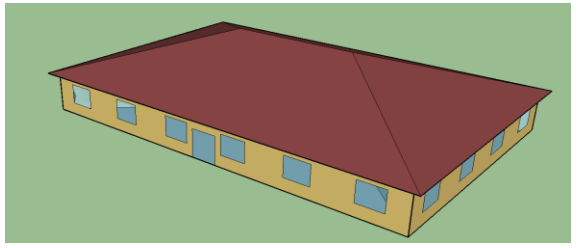

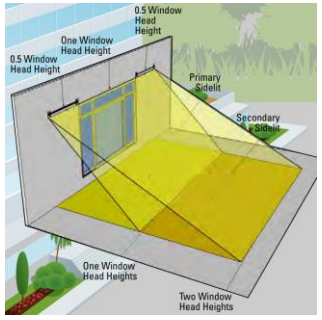

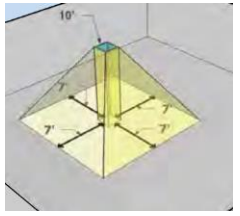

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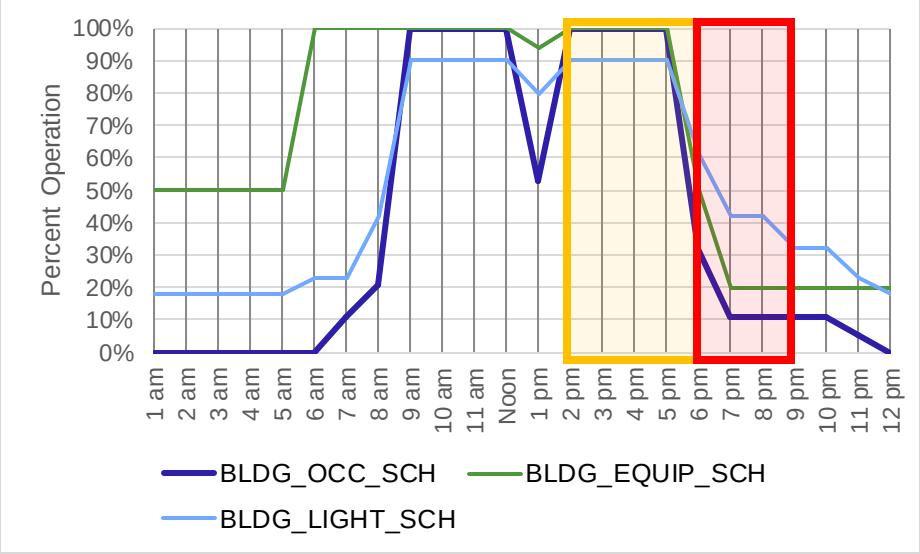

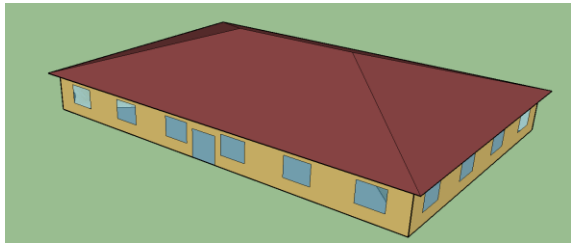

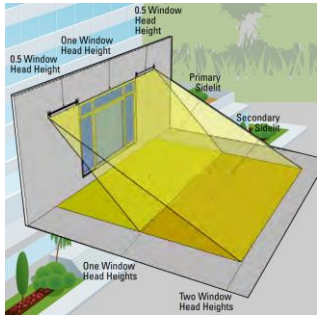

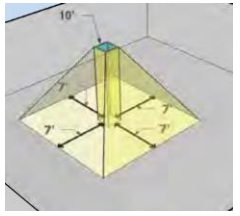

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Source: 2016 Energy Standards Lighting Fact Sheet: Nonresidential Daylighting and Daylighting Controls 2016, https://ww2.energy.ca.gov/title24/orc/lighting/2016_lighting.html

Energy Impacts Analysis Methodology *(continued)*

Occupancy Controls

Occupancy Controls

Occupancy Sensor Energy Savings

Space Type	Occupancy Sensor Lighting Energy Savings
Breakroom	29%
Classroom	40-46%
Conference Room	45%
Corridor	30-80%
Office, Private	13-50%
Office, Open	10%
Restroom	30-90%
Storage Area	45-80%
Warehouse	35-54%

Source: U.S. DOE EERE Wireless Sensors for Lighting Energy Savings; https://www.energy.gov/eere/femp/downloads/wireless-occupancy-sensors-lighting-controls-applications-guide-federal-facility

Energy Impacts Analysis Methodology *(continued)*

Occupancy Controls → Fraction of Top 88 Annual TDV Hours while Facility is Open (2-6PM)

Occupancy Controls → Fraction of Top 88 Annual TDV Hours while Facility is Closed (6-9PM)

Occupancy Sensor Energy Savings

Space Type	Occupancy Sensor Lighting Energy Savings
Breakroom	29%
Classroom	40-46%
Conference Room	45%
Corridor	30-80%
Office, Private	13-50%
Office, Open	10%
Restroom	30-90%
Storage Area	45-80%
Warehouse	35-54%

Small Office Top 1% TDV

Hours	Average TDV Hours	TDV $/kWh
2 to 6 PM	22	$ 41.62
6 to 9 PM	66	$ 16.71
Total	88	

Source: U.S. DOE EERE Wireless Sensors for Lighting Energy Savings; https://www.energy.gov/eere/femp/downloads/wireless-occupancy-sensors-lighting-controls-applications-guide-federal-facility

Energy Impacts Analysis Methodology *(continued)*

Occupancy Controls → Fraction of Top 88 Annual TDV Hours while Facility is Open (2-6PM)

Occupancy Controls → Fraction of Top 88 Annual TDV Hours while Facility is Closed (6-9PM)

→ TDV Savings from 15% Demand Reduction

Occupancy Sensor Energy Savings

Space Type	Occupancy Sensor Lighting Energy Savings
Breakroom	29%
Classroom	40-46%
Conference Room	45%
Corridor	30-80%
Office, Private	13-50%
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Small Office Top 1% TDV

Hours	Average TDV Hours	TDV $/kWh
2 to 6 PM	22	$ 41.62
6 to 9 PM	66	$ 16.71
Total	88	

Small Office DR Reduction & TDV Savings

Activity Area	Area Category Installed LPD (W/ft^2)	DR Reduction (Open/Closed Weighted Average; Watts)	TDV kBtu/ft^2
Break	0.69	8.5	0.92
CompRoomData	0.43		
Conference	0.83	11.3	0.85
CopyRoom	0.36		
Hall	0.43		
LobbyWaiting	0.83	16.4	1.11
MechElecRoom	0.43		
OfficeOpen	0.58	69.1	0.77
OfficeSmall	0.65	43.0	0.73
RestRoom	0.75	6.4	0.66
StorageSmlCond	0.33		
Total:		154.7	
Area-Weighted Average:			0.79

DR lighting is only required for spaces with an LPD >0.5 W/ft^2

Source: U.S. DOE EERE Wireless Sensors for Lighting Energy Savings; https://www.energy.gov/eere/femp/downloads/wireless-occupancy-sensors-lighting-controls-applications-guide-federal-facility

Energy Impacts Analysis Methodology *(continued)*

Energy Savings Calculation Steps:

1. Area Category method to established expected installed wattage
2. Facility open/closed operations
3. Daylighting
4. Occupancy sensors
5. TDV
6. 15% Reduction
7. Scaled by square footage for cost comparison and statewide analysis

Are we missing any significant steps that need to be accounted for?

Incremental Cost Information

Over 15 Year Period of Analysis

Two Pathways

Pathway 1:

Networked Lighting Controls with Native OpenADR Add-on

Hardware	Hardware Cost	Labor Hours	Labor Rate	Total:
Acuity nADR	$350	1	$116.02	
15% Markup	$52.50			
Sales Tax	$30.19			
Total:	$432.69		$116.02	**$549.71**

To Scale:

- One Acuity nADR can connect to five nLight Eclpyse controllers.
- One nLight Eclpyse controllers can control up to 750 end nodes.
- Assume a single 32 watt 2x4 troffer represents a single end node.

Pathway 2:

Piecemeal Wireless Control System with Non-Native OpenADR Virtual End Node (VEN)

Hardware	Hardware Cost	Labor Hours	Labor Rate	Total:
Universal Devices ISY994i ZW+	$179.00	2	$116.02	
PLM	$79.89			
15% Markup	$38.85			
Sales Tax	$22.34			
Total:	$320.16		$232.04	**$552.21**

To Scale:

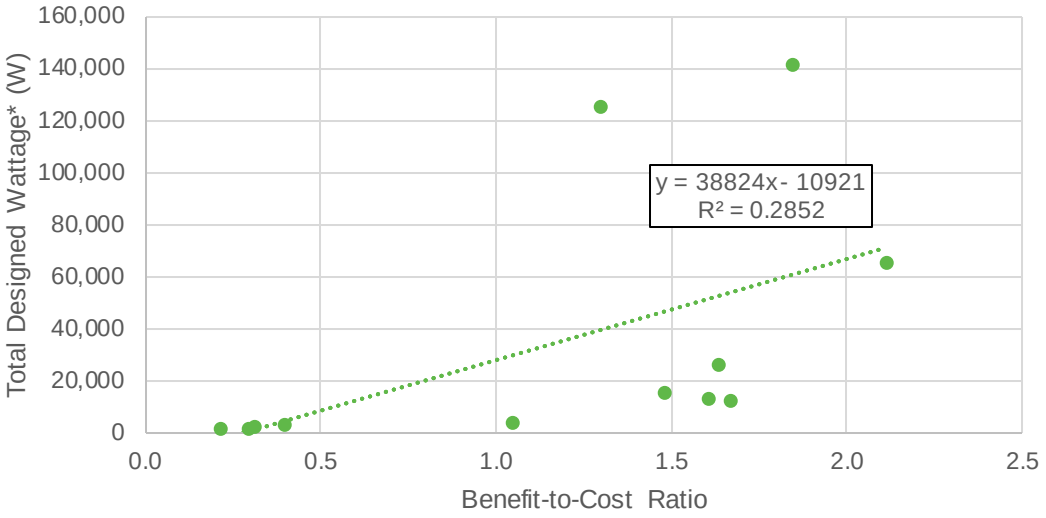
- One ISY994i ZW+ can connect to 254 end nodes.
- Assume a single 32 watt 2x4 troffer represents a single end node.

Any significant concerns with these pathways?

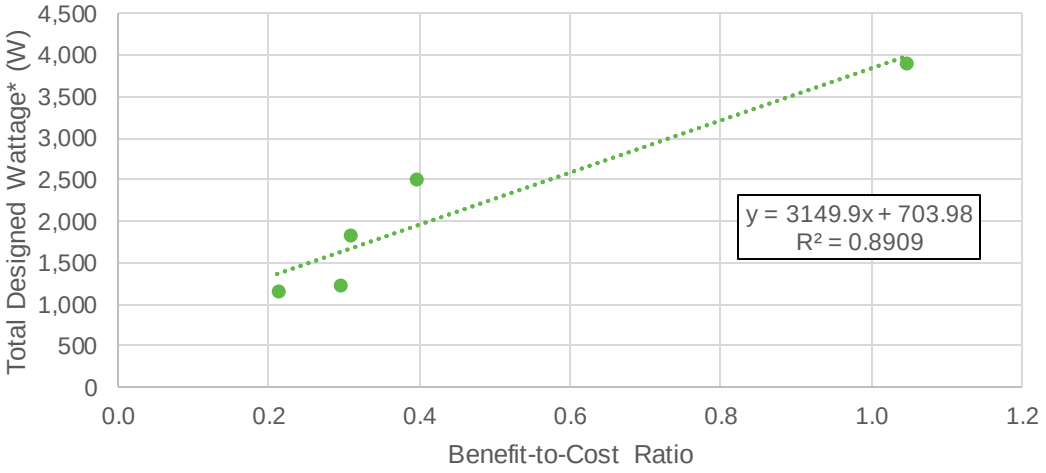
Cost Effectiveness Results

Building Model	Benefit to Cost Ratio (B/C)	Model ft^{2*}	Total Designed Wattage*
Office Large	1.85	393,872	141,408
Retail Large	1.30	203,726	125,210
Secondary School	2.11	150,889	64,901
Primary School	1.64	62,312	26,168
Office Medium	1.48	42,574	15,547
Stand-Alone Retail	1.61	19,920	13,055
Strip Mall	1.67	14,682	11,892
Retail Mixed Use	1.05	6,118	3,901
Small Hotel	0.40	5,832	2,516
Office Small	0.31	4,392	1,822
Quick Service Restaurant	0.30	2,256	1,230
Non-Refrigerated Warehouse	0.21	3,852	1,162

*For spaces with installed LPD greater than 0.5 W/ft2



Models Smaller than 10,000 ft^2 and 5,000 Total Designed Wattage*



If B/C (x) = 1; Wattage (y) = 3,854

Cost Effectiveness Results

Building Model	Benefit to Cost Ratio (B/C)	Model ft^{2*}	Total Designed Wattage*
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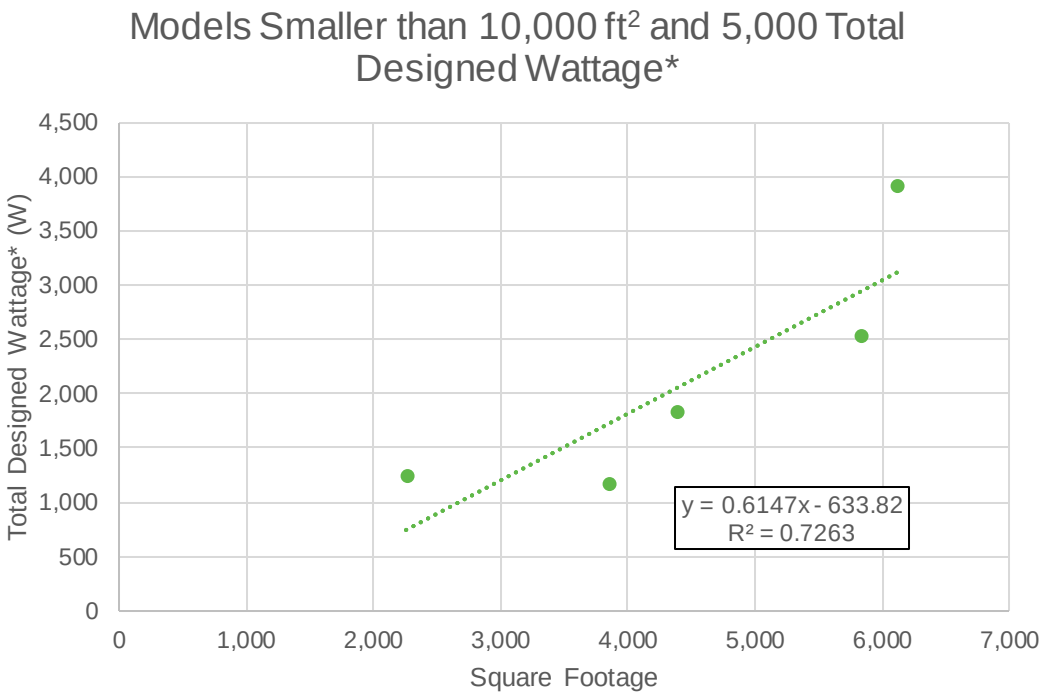


If Wattage (y) = 4,000; Square Footage (x) = 7,538

Compliance and Enforcement

- Acceptance Test

DR Acceptance Test Amendments

Current Demand Responsive Lighting Acceptance Test, NA7.6.3

- Reduce lighting power by at least 15%.
- Two test methods: measure illuminance or current.
- Two tests: maximum and minimum outputs.
- Do not reduce more than 50% designed illuminance of any space from daylight and electric light.

Proposed Demand Responsive Lighting Acceptance Test, NA7.6.3

- Reduce lighting power by at least 15%
- Three test methods: measure illuminance, current, or whole building with disaggregated circuits by end-use.
- Two tests: maximum and minimum outputs.

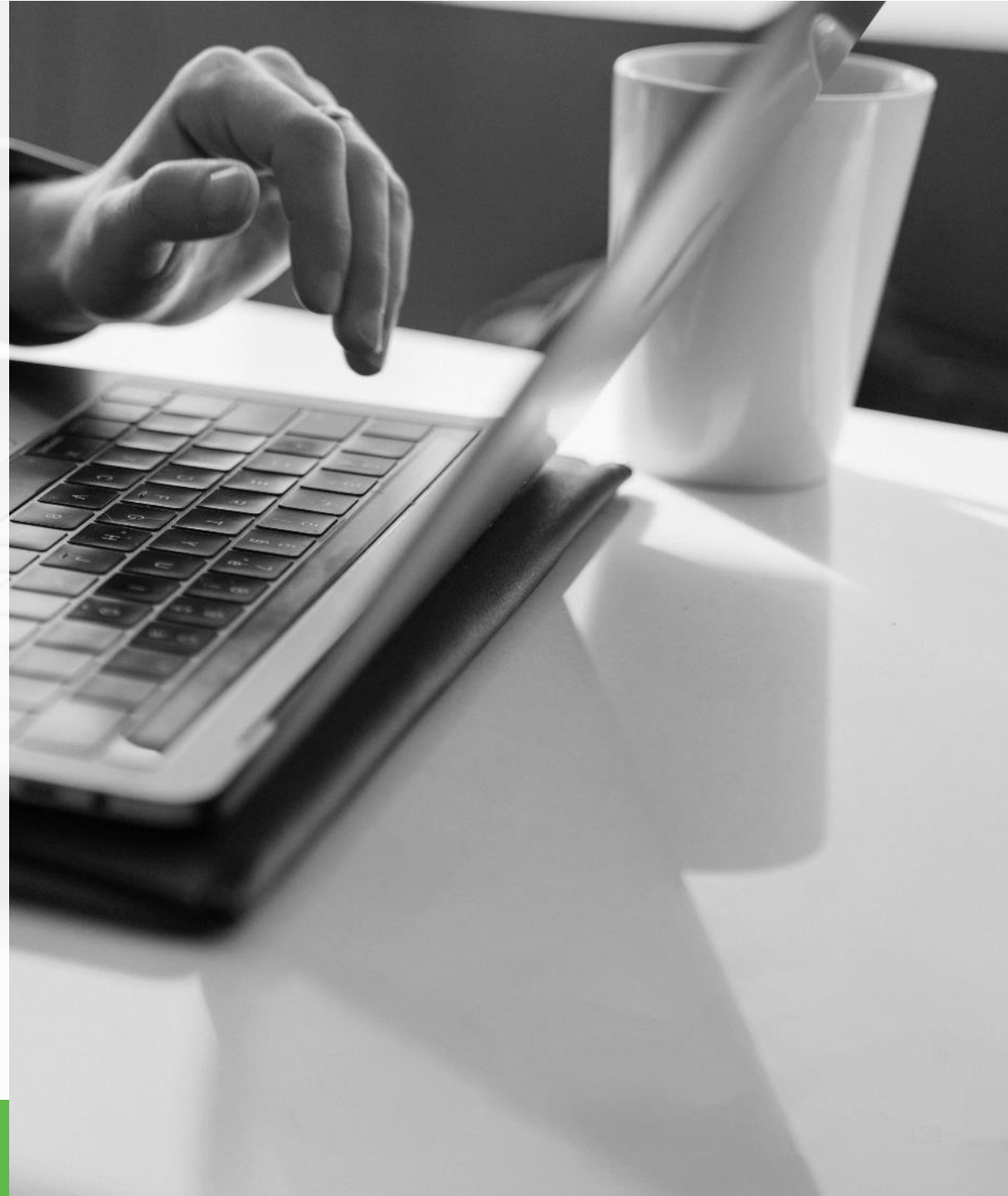
Poll

Is the acceptance test requirement necessary that requires demand responsive lighting to not reduce the combined illuminance from daylight and electric light below 50% of designed illuminance of any one space?

A. Useful or Appropriate
B. Unnecessary or Inappropriate
C. Other (Please Specify Below)

Proposed Code Changes

- Overview Code Change Language



Draft Code Change Language

- **Updated** draft code language for this submeasure is available in the **resources tab.**

General updates to Standards Section 110.12, Mandatory Requirements for Demand Management:

1. Linking the 0.5 W/ft^2 exemption with the multi-level lighting exemption of the same.
2. Replacing the 10,000 square foot threshold with 4,000 watts of total designed wattage.
3. Removing the 50% illuminance threshold of the acceptance test and introduce a third test method that tests at the whole building level.

Thank You

Questions?

David Jagger

Energy Solutions

(510) 482-4420 x451

djagger@energy-solution.com

CALIFORNIA ENERGY CODES & STANDARDS

A STATEWIDE UTILITY PROGRAM

2022 CALIFORNIA ENERGY CODE (TITLE 24, PART 6)

Multi-zone Occupancy Sensing in Large Offices

Codes and Standards Enhancement (CASE) Proposal

Nonresidential | Indoor Lighting

Marissa Lerner, *Energy Solutions*

March 3, 2020

CALIFORNIA ENERGY CODES & STANDARDS

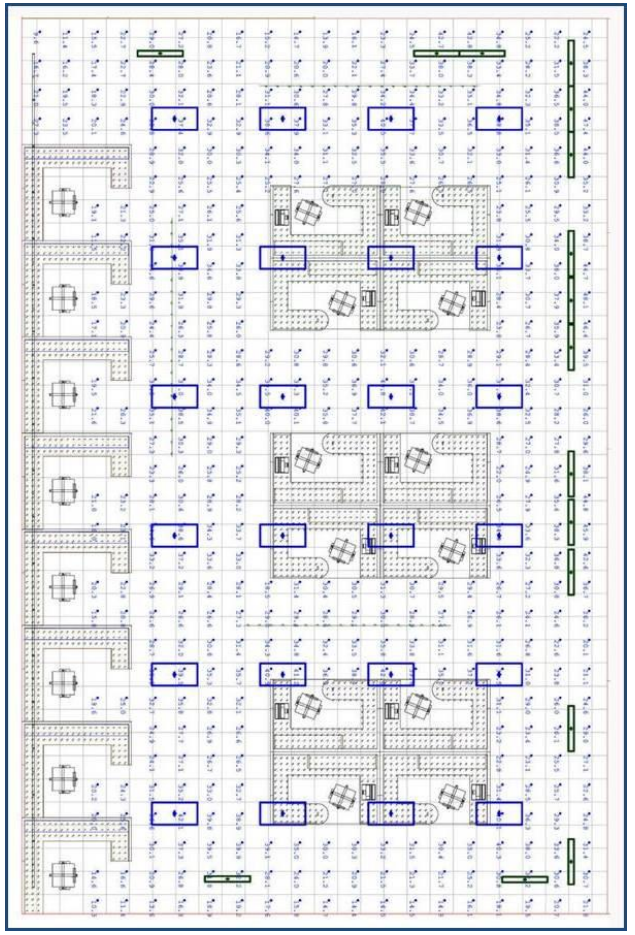
A STATEWIDE UTILITY PROGRAM

Multi-zone Occupancy Sensing in Large Offices Proposal – Submeasure Summary

This proposal would harmonize with the 2018 IECC:

- Require multi-zone occupancy sensing of general lighting in large offices (offices > 250 ft^2).
- When the control zones (≤ 600 sf in IECC) are unoccupied, each control zone must dim the lights to no greater than 20% of power or light
- When all control zones are unoccupied in the large office, the lights must be completely shut off.
- Large offices would qualify for occupied standby mode HVAC control (t-stat setpoints reset and ventilation turned off when entire room is empty).

Building Types	System Type	Type of Change	Software Updates Required
Offices > 250 square ft	Lighting	Mandatory	Schedule



Seeking Stakeholder Input:

- ❑ **Cost Estimates**
  - Equipment
    - Occupied Standby (e.g., Aux, BACnet)
  - Installation
  - Commissioning
- ❑ **Acceptance Testing** Updates
- ❑ **Compliance** and Enforcement Impacts
- ❑ Typical **Timeclock Schedules**

Opportunities for Engagement:

- Contact CASE Authors

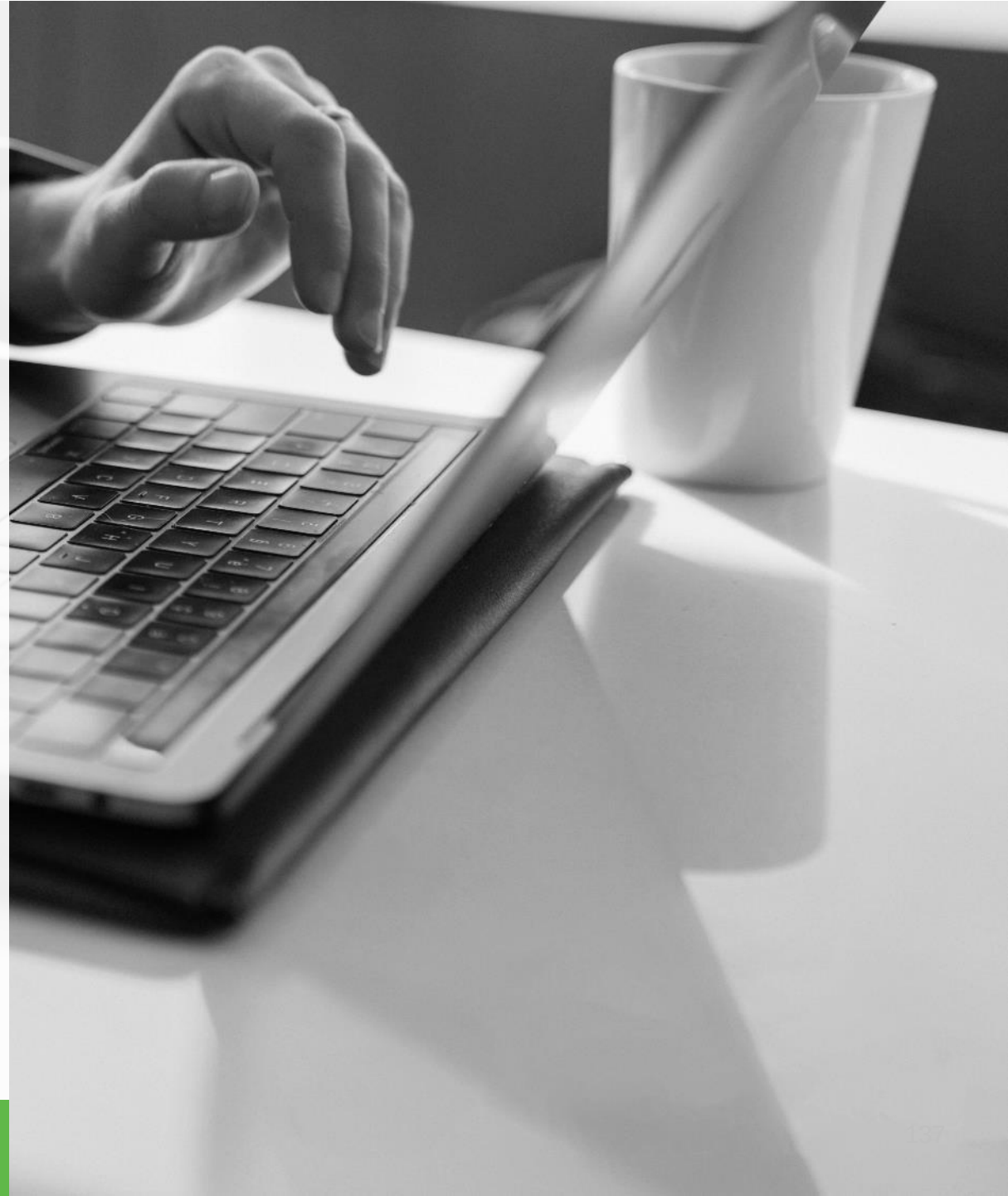
  Marissa Lerner, *Energy Solutions*

  mlerner@energy-solution.com

  Dr. Yao-Jung Wen, *Energy Solutions*

  ywen@energy-solution.com

- Review Draft CASE Report
  - Publicly available **April 2020**



2022 CALIFORNIA ENERGY CODE (TITLE 24, PART 6)

Indoor Lighting Power Densities

Codes and Standards Enhancement (CASE) Proposal

Nonresidential | Indoor Lighting

Chris Uraine, *Energy Solutions*

March 3, 2020

CALIFORNIA ENERGY CODES & STANDARDS

A STATEWIDE UTILITY PROGRAM

Agenda

1. Today's Objectives
2. Proposal Background
3. Technical Considerations
4. Cost and Energy Preliminary Findings
5. Proposed Language and Clean-up
6. Questions and Next Steps

Today's Objectives

The focus of today's meeting includes:

1. **Review** Updated Lumen Method Spreadsheet Assumptions
2. **Revisit** Lighting Power Adjustment Updates
   - Small Aperture Tunable-White
   - Dim-to-Warm Luminaires
3. **Review** Energy Savings and Cost Effectiveness Calculations
4. **Review** Proposed Code and Language Clean-up

Proposal Background

Lighting Power Density (LPD) Proposal Summary

Submeasure	Type of Change	Software Updates Required	Sections of Code Updated	Compliance Documents Updated
Indoor LPD	Prescriptive	Y	140.6	NRCC-LTI-E
Indoor LPD	Mandatory	N	130.0(c)	NRCI-LTI-01-E
Large Office Multi-Zone Occupancy Sensing	Mandatory	N	130.1(c)	NRCI-LTI-02-E

Description of Changes

- Update Allowed Lighting Power Densities
  - Remove complexity – simplify requirements and remove outdated requirements
  - Refine LPDs – small adjustments relative to changes from 2019 cycle

Code Change Proposal: Additional Resources

First-Utility Sponsored Meeting

The Statewide CASE Team held its first utility-sponsored stakeholder meeting for this topic on **September 12, 2019.**

Resources on Title24stakeholders.com

Presentation slides and **Submeasure summary** documents available that cover the following:

- ✓ Measure Background
- ✓ Market Overview & Analysis
- ✓ Technical Feasibility
- ✓ Compliance & Enforcement
- ✓ Draft Code Language

Also available in the **resources tab in today's presentation.**

Technical Considerations

- Lumen Method Spreadsheet Updates and Assumptions
- High Efficacy Product Availability
- Efficacy of High CRI, Color Tuning, and Small vs Large Aperture

Updates to Inverse Lumen Method Spreadsheet

1. **Mapping** design illuminances **to IES Standards** and handbook
2. **Fraction** task to circulation areas
3. **Wall Wash** model with added reflectances

Updates continued on next slide

Updates to Inverse Lumen Method Spreadsheet (continued)

4. **Revisited** surface **reflectances**

5. Luminaire dirt depreciation

6. **DLC data** for luminaire efficacy (when available)

Key Assumptions for LPD

Light Levels by Area

- The following 10 slides present assumptions about light levels for each space type
  - Assumptions in **red** have reduced since the 2019 code cycle
  - Assumptions in **green** have increased since the 2019 code cycle
- Statewide CASE Team will calculate LPDs based on updated assumptions

Have feedback about these assumptions?
Comments today and through info@title24stakeholders.com are welcome.

Assumptions for LPD Development

Light Levels by Area (1 of 10)

Area Name	**General lighting** foot-candle level	**General lighting** % of floorspace it applies to	IES Reference Standard	**Task lighting** foot-candle level	**Task Lighting** % of floorspace it applies to	IES Reference Standard	**Supplemental Lighting** foot-candle level	**Supplemental Lighting** % of floorspace it applies to	IES Reference Standard	Area Reflectance Assumptions (ceiling/wall/floor)
Audience Seating	10	100%	Handbook Table 24.2 – Auditoria lecture hall	0	0%	Task included with circulation	0	0%	N/A	70 / 30 / 10
Auditorium	15	0%	Handbook Table 24.2 – Auditoria Prefunction (pre/post event)	30	100%	Handbook Table 24.2 – Auditoria Testing / Combination (read/write)	0	0%	N/A	70 / 50 / 20
Auto Repair / Maintenance Shop	**15**	**90%**	WH –NA RP-7 Industrial	**0**	**0%**	Basic task included with circulation	**100**	**10%**	Handbook Table 24.2 Classroom / shop worktable / bench	40 / 40 / 10
Beauty Salon	10	20%	Cosmetology Industry (Freestyle Systems): General	50	60%	Cosmetology Industry (Freestyle Systems): Task	100	15%	Cosmetology Industry (Freestyle Systems): Hair Styling	70 / 50 / 20
Civic Meeting Place	10	30%	RP-3 Table 3g Circulation	30	70%	RP 3 Table 3g Conferencing	0	0%	N/A	80 / 50 / 20
Classroom, Lecture, Training, Vocational Area	10	0%	RP-3 Table 3c Classroom General; Average of AV and dedicated VDT screen	40	100%	RP-3 Table 3c Classroom Hardcopy and writing	0	0%	N/A	80 / 50 / 20
Commercial / Industrial Storage: Warehouse	10	100%	WH –NA; Handbook Table 31.2 – Support / Storage	0	0%	Task included with circulation	0	0%	N/A	40 / 40 / 10
Commercial / Industrial Storage: Shipping & Handling	10	90%	HB Table 22.2 - Support Spaces: Shipping Dock	30	10%	HB Table 22.2 - Support Spaces: Shipping - Receiving Staging	0	0%	N/A	40 / 40 / 10

Assumptions in **red** have reduced since the 2019 code cycle. Assumptions in **green** have increased since the 2019 code cycle

Assumptions for LPD Development

Light Levels by Area (2 of 10)

Area Name	**General lighting** foot-candle level	**General lighting** % of floorspace it applies to	IES Reference Standard	**Task lighting** foot-candle level	**Task Lighting** % of floorspace it applies to	IES Reference Standard	**Supplemental Lighting** foot-candle level	**Supplemental Lighting** % of floorspace it applies to	IES Reference Standard	Area Reflectance Assumptions (ceiling/wall/floor)
Concourse and Atria	10	**80%**	RP 2 Table J2 Interior Mall - Concourse	**30**	**20%**	RP 2 Table J2 Interior Mall - Kiosk (sales)	**0**	**0%**	N/A	50 / 30 / 20
Convention, Conference, Multipurpose and Meeting Area	**10**	**30%**	RP 3 Table 3g Circulation	**30**	**70%**	RP 3 Table 3g Conferencing	**0**	**0%**	N/A	80 / 50 / 20
Copy Room	10	60%	RP 1 Table B1k Support Copy/Print room: General	30	40%	RP 1 Table B1k Support Copy/Print room: Machines	0	0%	N/A	80 / 50 / 20
Corridor/Stairwell Area	5	100%	HB Table 22.2 - Transition Space; Corridor	0	0%	Task included with circulation	0	0%	N/A	80 / 50 / 20
Dining Area: Bar/Lounge and Fine Dining	3	60%	HB Table 22.2 - food service; Dinning areas	7.5	35%	IES-RP-10-19 (Common Appl.) Table Food Service: Dining Area, Relaxed or Fine	30	10%	IES-RP-10-19 (Common Appl.) Table Food Service: Serveries, Cashier	40 / 40 / 10
Dining Area: Cafeteria/Fast Food	10	60%	HB Table 22.2 - food service; Dinning areas	15	30%	IES-RP-10-19 (Common Appl.) Table Food Service: Dining Area, Cafeteria or Fast food	30	10%	IES-RP-10-19 (Common Appl.) Table Food Service: Serveries, Cashier	70 / 50 / 10
Dining Area: Family and Leisure	**3**	**60%**	HB Table 22.2 - food service; Dinning areas	10	**40%**	IES-RP-10-19 (Common Appl.) Table FoodService: Dining Area, Fast Casual.	0	0%	N/A	70 / 50 / 10

Assumptions in **red** have reduced since the 2019 code cycle. Assumptions in **green** have increased since the 2019 code cycle

Assumptions for LPD Development

Light Levels by Area (3 of 10)

Area Name	**General lighting** foot-candle level	**General lighting** % of floorspace it applies to	IES Reference Standard	**Task lighting** foot-candle level	**Task Lighting** % of floorspace it applies to	IES Reference Standard	**Supplemental Lighting** foot-candle level	**Supplemental Lighting** % of floorspace it applies to	IES Reference Standard	Area Reflectance Assumptions (ceiling/wall/floor)
Kitchen/Food Preparation Area	20	40%	HB Table 22.2 - Food service/General	0	0%	Basic tasks included with circulation	50	60%	RP-10-19 - Food Preparation/ Handling & Cleaning	70 / 50 / 20
Electrical, Mechanical, Telephone Rooms	20	100%	HB Table 22.2 - support spaces	0	0%	Portable	0	0%	N/A	70 / 30 / 10
Exercise/Fitness Center and Gymnasium Area	30	100%	HB Table 24.2 ports/Gym - General activities	0	0%	Task included with circulation	0	0%	N/A	40 / 40 / 10
Financial Transaction Area	10	60%	HB Table 31.2 Financial Facilities - Banking lobby: General	30	30%	HB Table 31.2 Financial Facilities - Banking lobby: Teller Window	50	10%	HB Table 31.2 Financial Facilities - Banking lobby: processing, inspection	70 / 50 / 10
General/Commercial & Industrial Work Area: Low Bay	15	60%	WH - NA, RP7 Table A3 Industrial - General shop areas	30	30%	IES-RP-7 (Industrial) Table A3 Industrial Component manufacturing: Large	100	10%	IES-RP-7 (Industrial) Table A3 Industrial Component manufacturing: Fine or Assembly: Difficult	50 / 30 / 20
General/Commercial & Industrial Work Area: High Bay	15	60%	WH - NA, RP7 Table A3 Industrial - General shop areas	30	30%	IES-RP-7 (Industrial) Table A3 Industrial Component manufacturing: Large	100	10%	IES-RP-7 (Industrial) Table A3 Industrial Component manufacturing: Fine or Assembly: Difficult	50 / 30 / 20

Assumptions in **red** have reduced since the 2019 code cycle. Assumptions in **green** have increased since the 2019 code cycle

Assumptions for LPD Development

Light Levels by Area (4 of 10)

Area Name	**General lighting** foot-candle level	**General lighting** % of floorspace it applies to	IES Reference Standard	**Task lighting** foot-candle level	**Task Lighting** % of floorspace it applies to	IES Reference Standard	**Supplemental Lighting** foot-candle level	**Supplemental Lighting** % of floorspace it applies to	IES Reference Standard	Area Reflectance Assumptions (ceiling/wall/floor)
General/Commercial & Industrial Work Area: Precision	0	0%	N/A	150	95%	RP7 (Industrial) Table A3 - Building Lighting: General Shop Area	300	5%	RP7 (Industrial) Table A3 - Assembly: Exacting	70 / 40 / 10
Hotel Function Area	10	30%	RP 3 Table 3g Circulation	30	70%	RP 3 Table 3g Conferencing	0	0%	N/A	80 / 50 / 20
Scientific Laboratory Area	50	90%	WH - NA, RP-7 Table A3 Lab-General	0	0%	Task included with circulation	100	10%	WH - NA, RP-7 Table A3 Lab-Benches	80 / 50 / 20
Laundry Area	30	100%	HB Table 28.2 -H & E support area	0	0%	Task included with circulation	0	0%	N/A	70 / 50 / 10
Library : Reading Area	**50**	**100%**	RP 4 Table 1c Library Proper- Reading room/areas	**0**	**0%**	Task included with circulation	0	0%	N/A	80 / 50 / 20
Library : Stacks Area	**20**	**40%**	RP 4 Table 1b Library Stacks - General	**30**	**60%**	RP 4 Table 1b Library Stacks on shelves	0	0%	N/A	70 / 50 / 20
Main Entry Lobby	10	70%	DG -25 hotel/hospitality Table B1 Lobbies	15	25%	DG -25 hotel/hospitality Table B1 Lobbies (desk top & general reading)	50	5%	DG -25 Table B1: hotel/hospitality Reading Writing (Maximum)	70 / 40 / 10
Locker Room	**5**	**80%**	HB Table 31.2 - Locker Rooms - General/lockers	0	0%	Basic tasks included with circulation	**15**	**20%**	HB Table 31.2 - Locker Rooms - Vanity/mirrors	80 / 50 / 20

Assumptions in **red** have reduced since the 2019 code cycle. Assumptions in **green** have increased since the 2019 code cycle

Assumptions for LPD Development

Light Levels by Area (5 of 10)

Area Name	**General lighting** foot-candle level	**General lighting** % of floorspace it applies to	IES Reference Standard	**Task lighting** foot-candle level	**Task Lighting** % of floorspace it applies to	IES Reference Standard	**Supplemental Lighting** foot-candle level	**Supplemental Lighting** % of floorspace it applies to	IES Reference Standard	Area Reflectance Assumptions (ceiling/wall/floor)
Lounge, Breakroom, or Waiting Area	**10**	100%	HB Table 22.2 Support Spaces: Break/lunch rooms	0	0%	Task included with circulation	0	0%	N/A	80 / 50 / 20
Museum Area: Exhibition/Display	**5**	**90%**	RP 30 Table 8 Museum display - medium to sensitive fading products	0	0%	Task included with circulation	**20**	**10%**	RP 30 Table 8 Museum display - Low sensitivity to fading products	50 / 30 / 20
Museum Area: Restoration Room	**50**	**90%**	Not Identified in Museum Lighting used MFR Laboratory target (RP7 Table A3)	0	0%	Task included with circulation	**100**	**10%**	Not Identified in Museum Lighting used MFR Laboratory target (RP7 Table A3)s	80 / 50 / 20
Office Area: ≤ 250 sf	**10**	**40%**	RP 1 Table B1l - Transition/circulation	**30**	**60%**	RP 1 Table B1j - Reading/writing Typical tasks	**50**	10%	RP 1 Table B1j - Reading/writing detail/difficult tasks	80 / 50 / 20
Office Area: > 250 sf and ≤ xxx sf	**10**	**40%**	RP 1 Table B1l - Transition/circulation	**30**	**60%**	RP 1 Table B1j - Reading/writing Typical tasks	**50**	10%	RP 1 Table B1j - Reading/writing detail/difficult tasks	80 / 50 / 20
Office Area: > xxx sf	**10**	**30%**	RP 1 Table B1l - Transition/circulation	**30**	**70%**	RP 1 Table B1j - Reading/writing Typical tasks	50	10%	RP 1 Table B1j - Reading/writing detail/difficult tasks	80 / 50 / 20

Assumptions in **red** have reduced since the 2019 code cycle. Assumptions in **green** have increased since the 2019 code cycle

Assumptions for LPD Development

Light Levels by Area (6 of 10)

Area Name	**General lighting** foot-candle level	**General lighting** % of floorspace it applies to	IES Reference Standard	**Task lighting** foot-candle level	**Task Lighting** % of floorspace it applies to	IES Reference Standard	**Supplemental Lighting** foot-candle level	**Supplemental Lighting** % of floorspace it applies to	IES Reference Standard	Area Reflectance Assumptions (ceiling/wall/floor)
Parking Garage Area: Parking Zone	5	**85%**	From safety reports, 5 fc. 1 fc RP8-18 Table 17.3 Parking Structures, 6 fc G1-16 for high security parking garages	**5**	**15%**	RP 20 Table 4 Parking Structures - Elevator lobby/zone & Stairs	50	0%	N/A	40 / 40 / 10
Parking Garage Area: Dedicated Ramps	2	100%	RP-8-18 Sec 17.5.1.1 Ramps/Entrances	0	0%	N/A	0	0%	N/A	40 / 40 / 10
Parking Garage Area: Daylight Adaptation Zones	50	100%	RP-8-18 Table 17.3	0	0%	N/A	0	0%	RP 20 parking structures - Vehicle entry/exit zone (daytime)	40 / 40 / 10
Retail Sales Area: Grocery Sales	20	**20%**	RP 2 Table J2 Indoor Sales floor (max allowed circulation all retail types)	**50**	**80%**	RP 2 Table J2 Retail Indoor Sales floor (max allowed retail sales types)	0	0%	N/A	70 / 50 / 20
Retail Sales Area: Retail Merchandise Sales	**20**	**20%**	RP 2 Table J2 Indoor Sales floor (max allowed circulation all retail types)	**50**	**80%**	RP 2 Table J2 Retail Indoor Sales floor (max allowed retail sales types)	0	0%	N/A	70 / 50 / 20
Retail Sales Area: Fitting Room	**30**	100%	RP 2 Table J2 Retail Indoor - Fitting Rooms	0	0%	Task included with circulation	0	0%	Task included with circulation	70 / 50 / 20

Assumptions in **red** have reduced since the 2019 code cycle. Assumptions in **green** have increased since the 2019 code cycle

Assumptions for LPD Development

Light Levels by Area (7 of 10)

Area Name	**General lighting** foot-candle level	**General lighting** % of floorspace it applies to	IES Reference Standard	**Task lighting** foot-candle level	**Task Lighting** % of floorspace it applies to	IES Reference Standard	**Supplemental Lighting** foot-candle level	**Supplemental Lighting** % of floorspace it applies to	IES Reference Standard	Area Reflectance Assumptions (ceiling/wall/floor)
Religious Worship Area	0	0%	N/A	40	80%	HB Table 37.2 Worship Blend of Contemporary/Traditional & Transitional Secondary Focal	75	20%	HB Table 37.2 Worship Blend of Contemporary/Traditional & Transitional Primary Focal - Sermon	70 / 50 / 10
Restrooms	5	60%	HB Table 31.2 - toilets	15	40%	HB Table 31.2 - toilets	0	0%	N/A	80 / 50 / 20
Theater Area: Motion picture	**5**	**0%**	HB Table 28.2 -H & E theater: circulation & task (seating)	**15**	**100%**	HB Table 28.2 -H & E theater: housekeeping	0	0%	N/A	30 / 10 / 20
Theater Area: Performance	10	0%	HB Table 28.2 -H & E theater, stage - audience pre/post intermission	15	100%	HB Table 28.2 -H & E theater, stage - cleanup	0	0%	N/A	50 / 30 / 20
Transportation Function : Baggage Area	10	**70%**	HB Table 36.2 - baggage claim	**20**	**30%**	HB Table 36.2 - baggage claim	0	0%	N/A	70 / 50 / 10
Transportation Function : Ticketing Area	**5**	**70%**	HB Table 36.2 - trans/ticketing: queuing	**30**	**30%**	HB Table 36.2 - trans/ticketing: agent counter	0	0%	N/A	80 / 50 / 20
Videoconferencing Studio	0	0%	N/A	50	80%	Non IES Reference : Video Conf Specialist ELP (Hedberg)	0	0%	N/A	80 / 50 /20

Assumptions in **red** have reduced since the 2019 code cycle. Assumptions in **green** have increased since the 2019 code cycle

Assumptions for LPD Development

Light Levels by Area (8 of 10)

Area Name	**General lighting** foot-candle level	**General lighting** % of floorspace it applies to	IES Reference Standard	**Task lighting** foot-candle level	**Task Lighting** % of floorspace it applies to	IES Reference Standard	**Supplemental Lighting** foot-candle level	**Supplemental Lighting** % of floorspace it applies to	IES Reference Standard	Area Reflectance Assumptions (ceiling/wall/floor)
Aging Eye/Low-vision: Main Entry Lobby	100	100%	RP 28 Table 1 - visually impaired lobby	0	0%	N/A	0	0%	N/A	80 / 50 / 20
Aging Eye/Low-vision: Stairwell	20	100%	RP 28 Table 1 - Visually impaired corridor	0	0%	N/A	0	0%	N/A	80 / 50 / 20
Aging Eye/Low-vision: Corridor Area	20	100%	RP 28 Table 1 - Visually impaired corridor	0	0%	N/A	0	0%	N/A	80 / 50 / 20
Aging Eye/Low-vision: Lounge/Waiting Area	**30**	**80%**	RP 28 Table 1 - Visually impaired Common living area	**50**	**20%**	RP 28 Table 1 - Visually impaired Common living area	0	0%	N/A	80 / 50 / 20
Aging Eye/Low-vision: Multipurpose Room	30	80%	RP 28 Table 1 - Visually impaired Common living area	50	20%	RP 28 Table 1 - Visually impaired Common living area	0	0%	N/A	80 / 50 / 10
Aging Eye/Low-vision: Religious Worship Area	10	40%	RP 28 Table 1 - Visually impaired chapel	30	60%	RP 28 Table 1 - Visually impaired chapel	0	0%	N/A	70 / 50 / 20
Aging Eye/Low-vision: Dining	20	40%	RP 28 Table 1 - Visually impaired dinning	50	60%	RP 28 visually impaired	0	0%	N/A	80 / 50 /20
Aging Eye/Low-vision: Restroom	20	60%	RP 28 Table 1 - Visually impaired restroom	50	40%	RP 28 visually impaired	0	0%	N/A	80 / 50 /20

Assumptions in **red** have reduced since the 2019 code cycle. Assumptions in **green** have increased since the 2019 code cycle

Assumptions for LPD Development

Light Levels by Area (9 of 10)

Area Name	**General lighting** foot-candle level	**General lighting** % of floorspace it applies to	IES Reference Standard	**Task lighting** foot-candle level	**Task Lighting** % of floorspace it applies to	IES Reference Standard	**Supplemental Lighting** foot-candle level	**Supplemental Lighting** % of floorspace it applies to	IES Reference Standard	Area Reflectance Assumptions (ceiling/wall/floor)
Healthcare Facility and Hospitals: Exam/Treatment Room	10	40%	RP 9 Table 2f General/circulation	50	30%	RP 9 Table 2f Diagnostic/Treatment - General Exam	100	30%	RP 9 Table 2f Diagnostic/Treatment - Injections. Etc.	80 / 50 / 20
Healthcare Facility and Hospitals: Imaging Room	10	70%	RP 29 Table 2d Imaging - booth/general	50	30%	RP 29 Table 2d Imaging - Diagnostic/reading	0	0%	N/A	80 / 50 / 20
Healthcare Facility and Hospitals: Medical Supply Room	0	90%	N/A	50	10%	RP 9 Table 2m Pharmacy Storage & Support Medication storage (equipment)	0	0%	RP 9 Table 2m Pharmacy Storage & Support Medication storage (controlled drugs)	80 / 50 / 20
Healthcare Facility and Hospitals: Nursery	10	60%	RP 9 Table 2l Nursery - General	30	30%	RP 9 Table 2l Nursery - Observation	50	10%	RP 9 Table 2l Nursery - Treatment	80 / 50 / 20
Healthcare Facility and Hospitals: Nurse's Station	30	80%	RP 9 Table 2j Nurses Station - General	50	20%	RP 9 Table 2j Nurses Station - Desk	0	0%	N/A	80 / 50 / 20
Healthcare Facility and Hospitals: Operating Room	200	0%	RP 9 Table 2o Surgical Setup/cleanup	200	100%	RP 9 Table 2o Surgical General	N/A	0%	Exempt - in equipment	80 / 50 / 20

Assumptions in **red** have reduced since the 2019 code cycle. Assumptions in **green** have increased since the 2019 code cycle

Assumptions for LPD Development

Light Levels by Area (10 of 10)

Area Name	**General lighting** foot-candle level	**General lighting** % of floorspace it applies to	IES Reference Standard	**Task lighting** foot-candle level	**Task Lighting** % of floorspace it applies to	IES Reference Standard	**Supplemental Lighting** foot-candle level	**Supplemental Lighting** % of floorspace it applies to	IES Reference Standard	Area Reflectance Assumptions (ceiling/wall/floor)
Healthcare Facility and Hospitals: Patient Room	10	30%	RP 9 Table 2k Patient room - General	40	60%	RP 9 Table 2k Patient room - Reading	75	10%	RP 9 Table 2k Patient room - Examination	80 / 50 / 20
Healthcare Facility and Hospitals: Physical Therapy Room	20	80%	RP 9 Table 2h Therapy - General/Group therapy	50	20%	RP 9 Table 2h Therapy - Table and Individual	0	0%	N/A	80 / 50 / 20
Healthcare Facility and Hospitals: Recovery Room	0	0%	Basic tasks included with circulation	30	80%	RP 9 Table 2k Special Care/Critical - General	100	20%	RP 9 Table 2k Special Care/Critical - Exam/treatment	80 / 50 / 20
Sports Arena – Playing Area: Class I Facility	0	0%	N/A	150	100%	RP 6 Table 9 - Sports lighting	0	0%	N/A	50 / 40 / 20
Sports Arena – Playing Area: Class II Facility	0	0%	N/A	100	100%	RP 6 Table 9 - Sports lighting	0	0%	N/A	50 / 40 / 20
Sports Arena – Playing Area: Class III Facility	0	0%	N/A	75	100%	RP 6 Table 9 - Sports lighting	0	0%	N/A	50 / 40 / 20
Sports Arena – Playing Area: Class IV Facility	0	0%	N/A	50	100%	RP 6 Table 9 - Sports lighting	0	0%	N/A	50 / 40 / 20

Assumptions in **red** have reduced since the 2019 code cycle. Assumptions in **green** have increased since the 2019 code cycle

Assumptions for LPD Development

Maintenance and Luminaire Dirt Depreciation (LDD)

Clean	Moderate	Dirty
Most Areas	Warehouses	Auto repair
	Dining	Manufacturing
	Kitchen	Parking garage
	Precision work	Loading dock
	Copy room	
	Restroom	
	Baggage claim	
	Sports arenas	

Luminaire Dirt Depreciation

- Based on IES RP-36
- Assumptions on period between cleanings:
  - **36 months:** most applications
  - **24 months:** Copy room, Warehouse, Manufacturing, Healthcare

Room Surface Dirt Depreciation

- ASHRAE 90.1 assumes 96% for all spaces
- **What should be assumed for Title 24?**

Assumptions for LPD Development

Lamp Lumen Depreciation (LLD)

LLD proportional to ratio of duration of LD70 and product of expected EUL and operating hours per year:

$$\boldsymbol{LDD} = 1 - 0.3 \times \left[\frac{EUL \times H/yr}{LD70}\right]$$

Annual Hours of Operation (*H/yr*):	Based on lighting schedule from Nonresidential ACM Reference Manual
	Appendix 5.4 expanded to annual hours
Expected Useful Life (*EUL*):	15 years for most applications
	7 years for retail
LD70:	Hours at which lamp lumen depreciation has reduced to 70%

Efficacy Assumptions and Market Availability

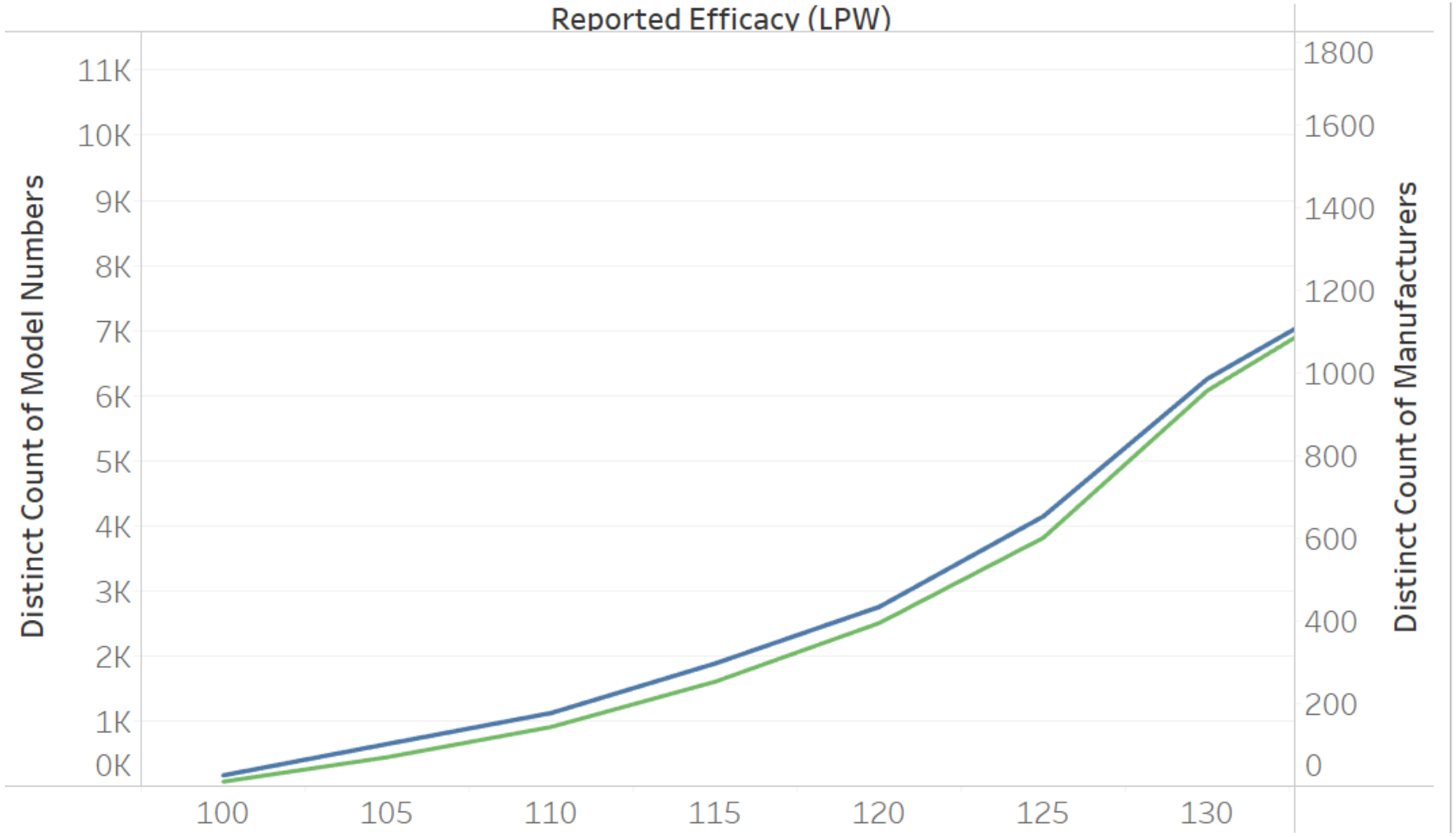
Selecting Luminaire Efficacy

- The following 4 slides present the number of manufacturers that currently produce products at the different efficacy levels
  - Based on DesignLights Consortium QPL
  - **What other lighting product databases should be used?**

- Will choose efficacy levels at about 70th percentile
  - High efficacy while ensuring adequate product availability

Efficacy Assumptions and Market

Selecting Luminaire Efficacy – **High Bay**

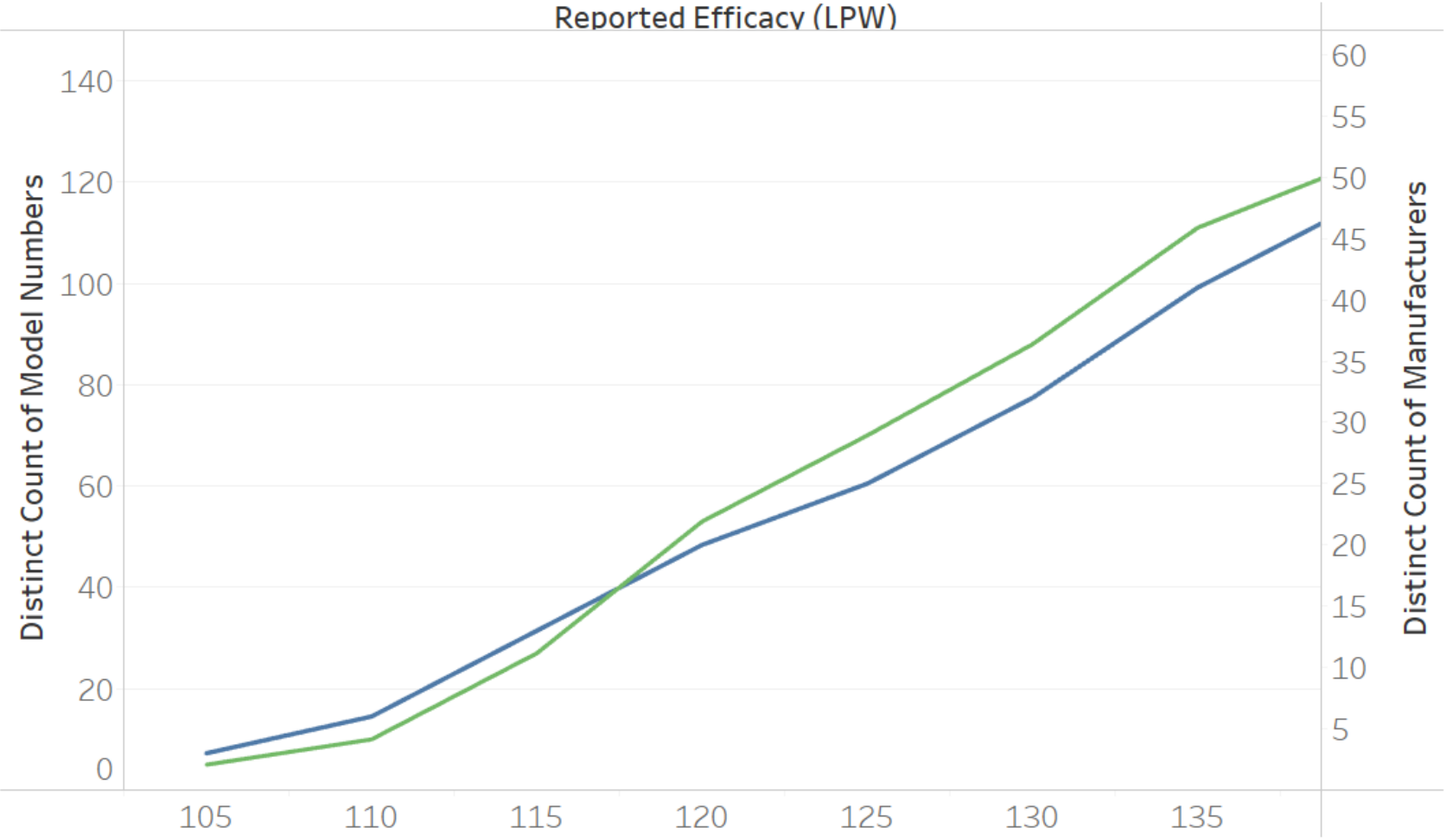


Model Number
Manufacturer

Source: DLC QPL Database. 12/18/2019

Efficacy Assumptions and Market

Selecting Luminaire Efficacy – **Low Bay**

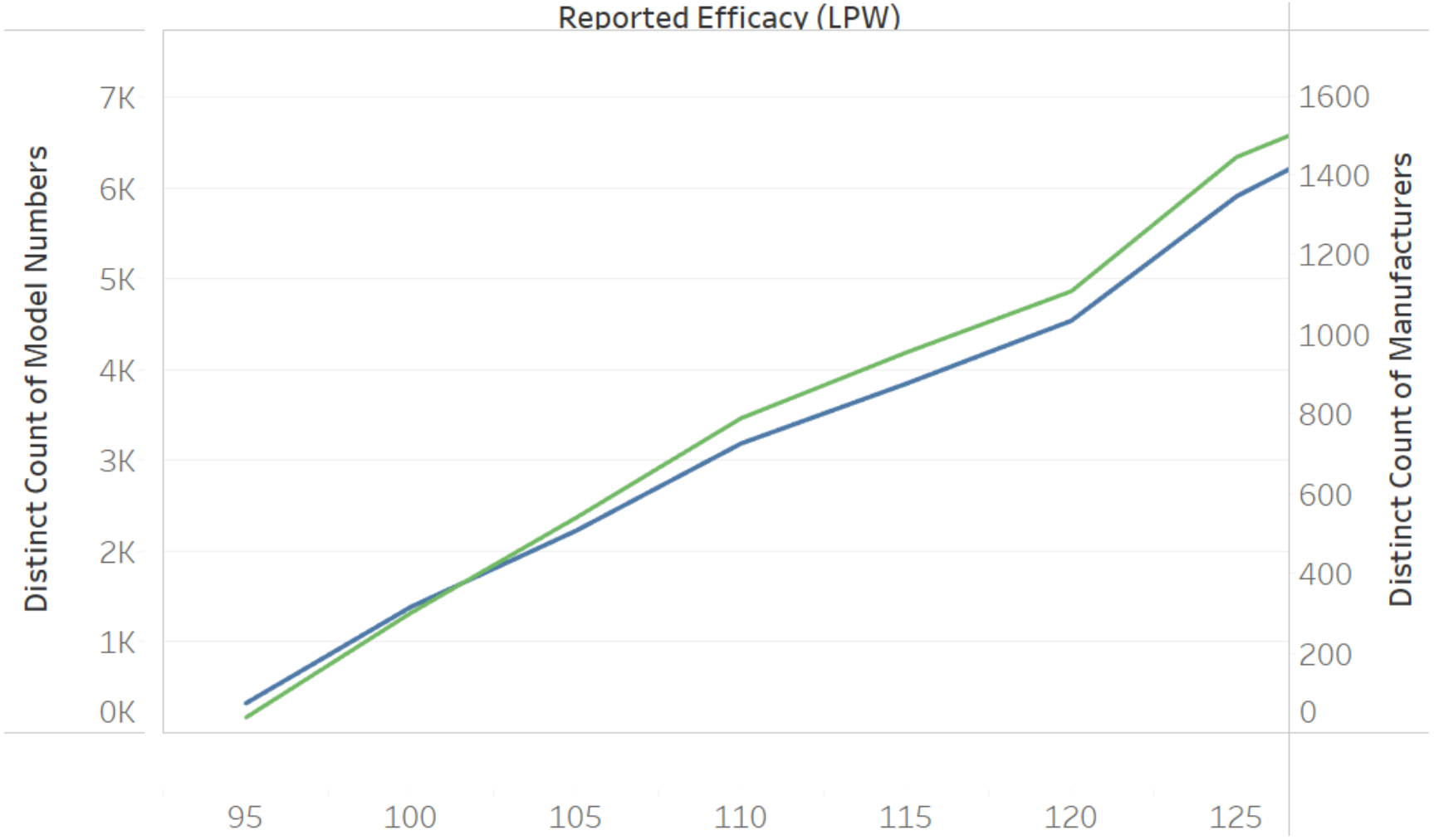


Model Number
Manufacturer

Source: DLC QPL Database. 12/18/2019

Efficacy Assumptions and Market

Selecting Luminaire Efficacy – **2 x 2 Troffers CRI < 90**

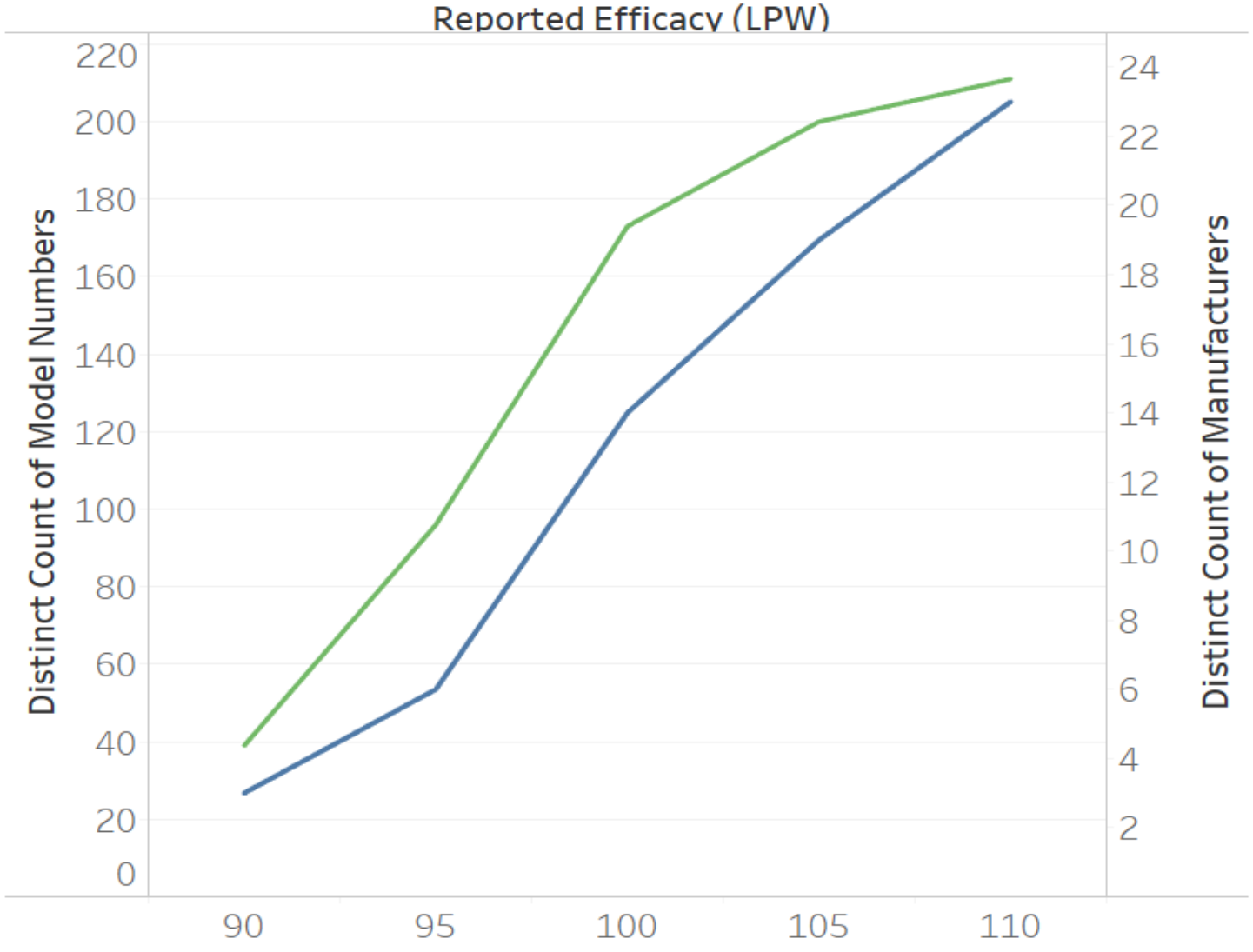


Model Number
Manufacturer

Source: DLC QPL Database. 12/18/2019

Efficacy Assumptions and Market

Selecting Luminaire Efficacy – **2 x 2 Troffers CRI ≥ 90**

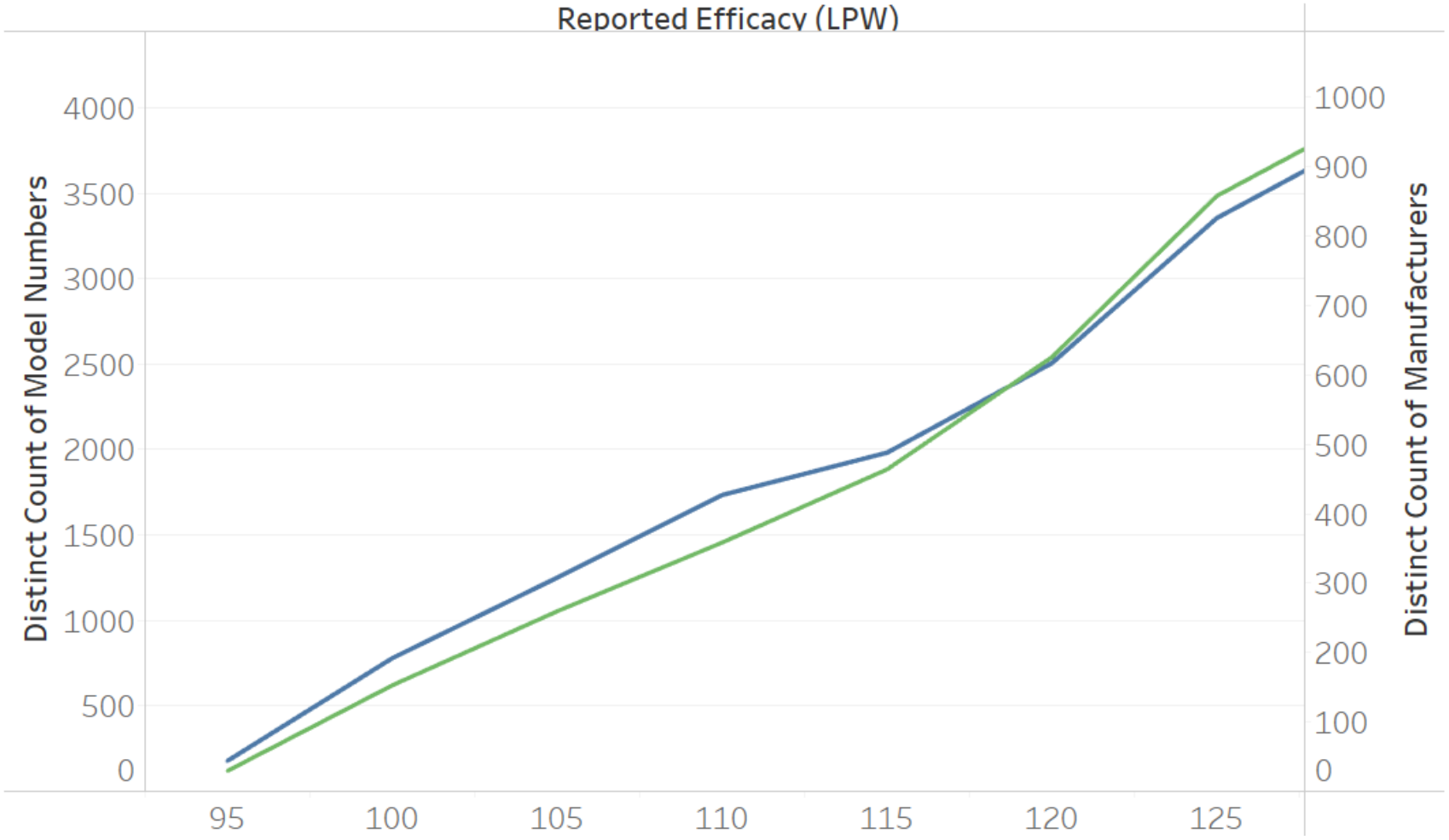


Model Number
Manufacturer

Source: DLC QPL Database. 12/18/2019

Efficacy Assumptions and Market

Selecting Luminaire Efficacy – **2 x 4 Troffers CRI < 90**

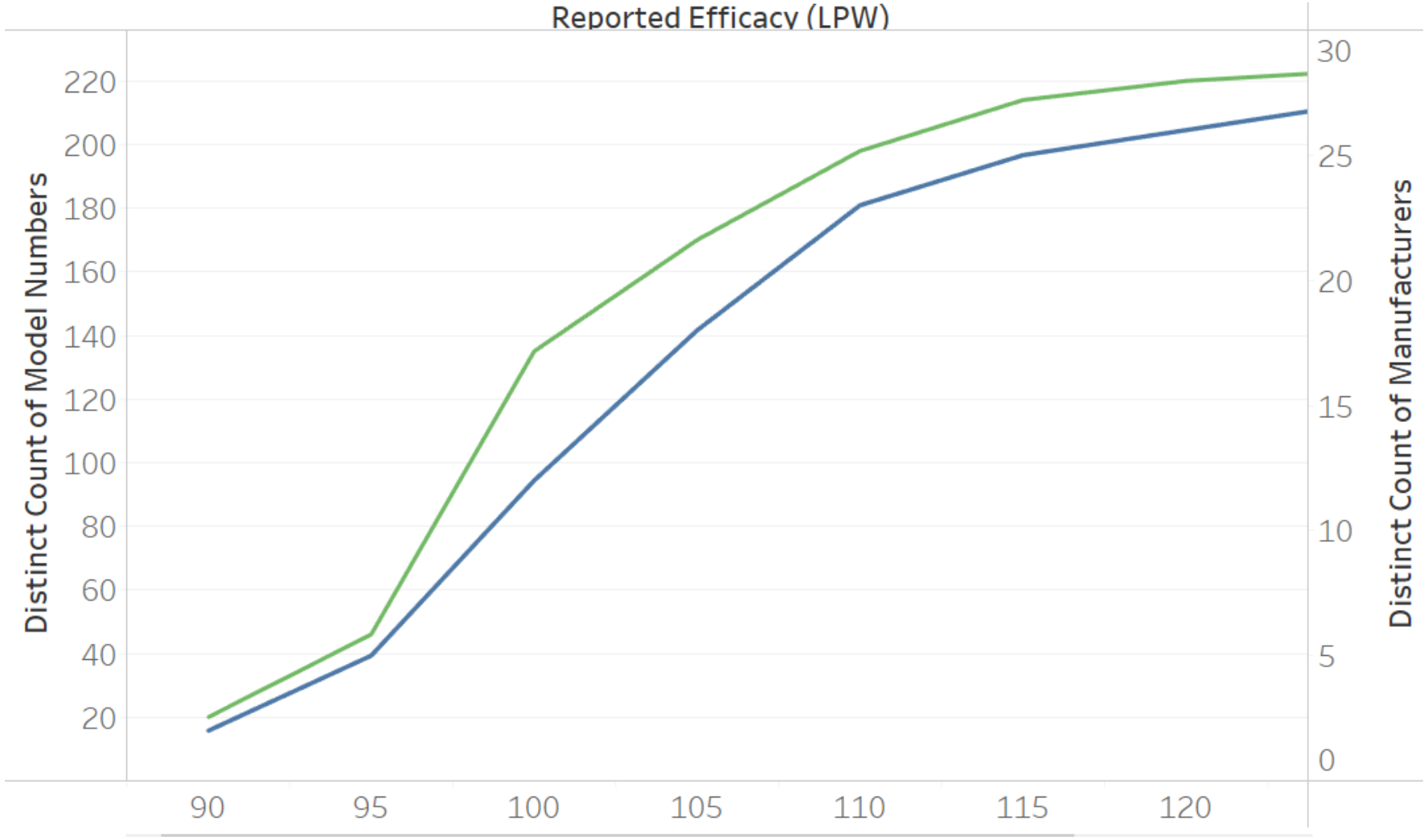


Model Number
Manufacturer

Source: DLC QPL Database. 12/18/2019

Efficacy Assumptions and Market

Selecting Luminaire Efficacy – **2 x 4 Troffers CRI ≥ 90**

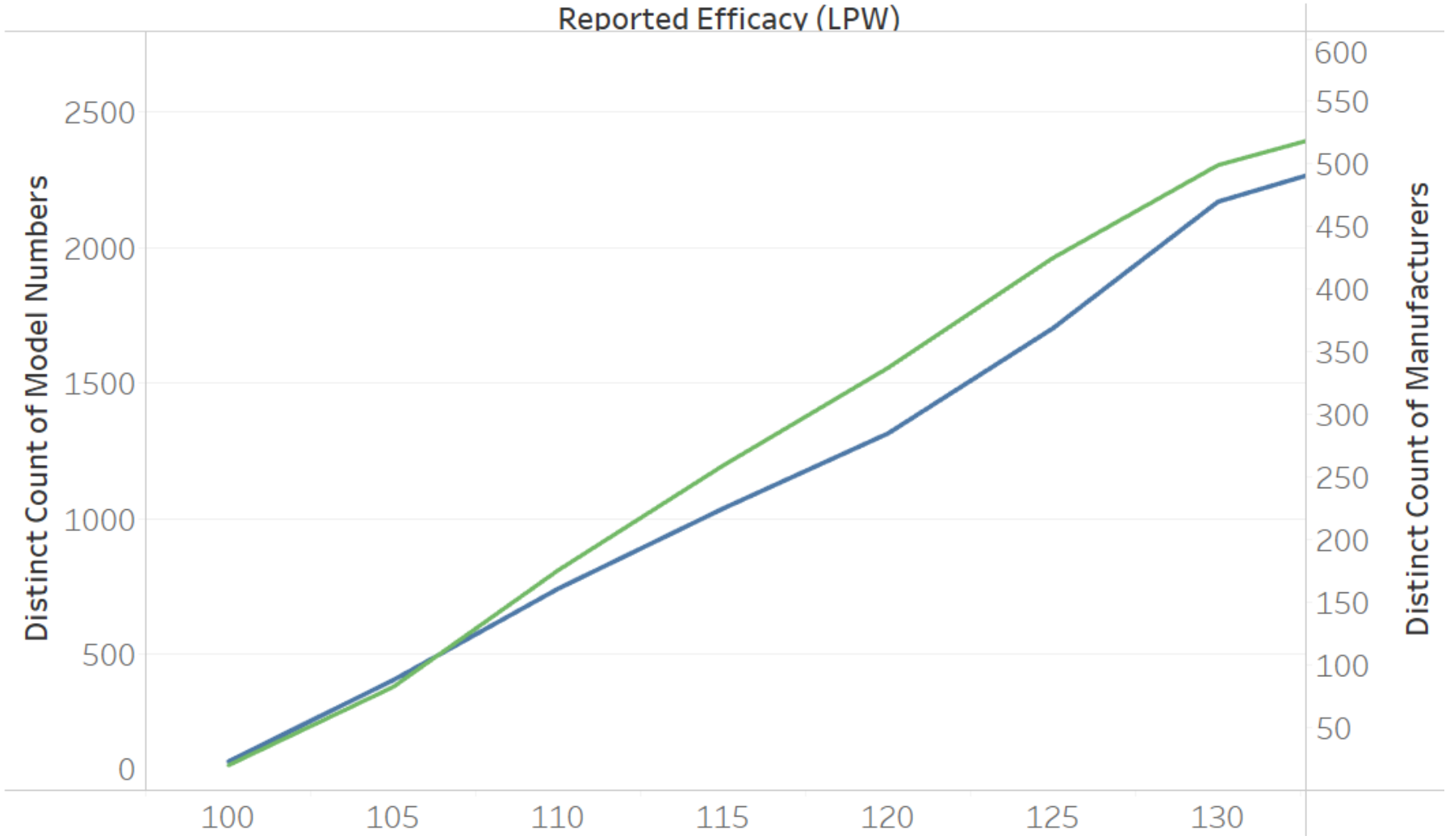


Model Number
Manufacturer

Source: DLC QPL Database. 12/18/2019

Efficacy Assumptions and Market

Selecting Luminaire Efficacy – **Direct Linear**

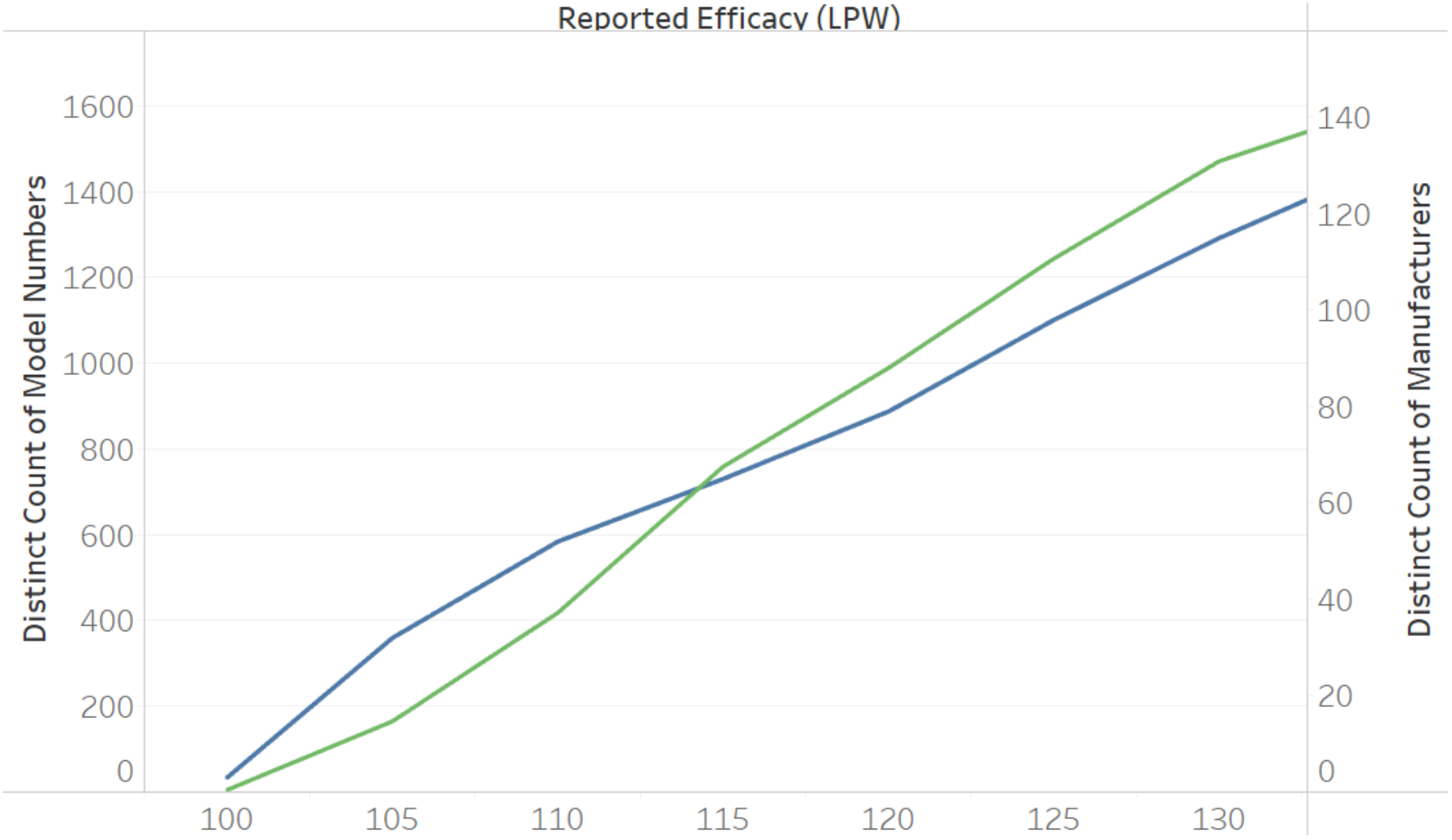


Model Number
Manufacturer

Source: DLC QPL Database. 12/18/2019

Efficacy Assumptions and Market

Selecting Luminaire Efficacy – **Indirect Linear**



Model Number
Manufacturer

Source: DLC QPL Database. 12/18/2019

Efficacy Increases for High CRI and Color Tuning

Small and large aperture, color tuning, and dim-to-warm

- The following slides present information about efficacy penalty for high CRI and color tuning products
  - Efficacy of high CRI and color tuning has increased since last code cycle
  - Opportunities to reduce LPDs and use-it-or-lose-it wattage adders
  - Results based on multiple products from multiple manufacturers

Efficacy of 80 CRI and 90 CRI

Manufacturer	Number of Products Evaluated	Efficacy Loss Between 80 CRI and 90 CRI
Manufacturer A	80	18%
Manufacturer B	126	18%
Manufacturer C	166	17%
Manufacturer D	32	16%
Manufacturer E	332	24%
Manufacturer F	336	14%
Manufacturer G	60	23%
Manufacturer H	67	19%
Manufacturer I	80	17%
Manufacturer J	84	18%
Manufacturer K	90	16%
Manufacturer L	60	23%
Manufacturer M	48	11%
Manufacturer N	48	25%
Manufacturer O	40	16%
13 Manufacturers	**1649**	**18%**

18%

Average efficacy loss
between 80 CRI and 90 CRI

- Efficacy difference between 80CRI and 90CRI is shrinking
- **2019 code cycle analysis found range of 25-30%**
- **Opportunity to reduce LPDs for spaces that require 90 CRI**

80 CRI Color Tuning Large Aperture

2x2 and 2x4 Troffers with Color Tuning											
Lumen/Watt at CCT	**Number of Products**	**2700**	**3000**	**3500**	**4000**	**4500**	**5000**	**5700**	**6500**	**Average LPW**	**Loss (%)**
Manufacturer A	10	118	121	126	130	133	134	135	130	128	0
Manufacturer B	10	118	121	123	127				128	123	4
Manufacturer C	72		115	123	121		126			121	10
Manufacturer D	8	91	89	95	98		102		110	98	9
Manufacturer E	12	111	116	118	120		125		121	119	2
Total	**112**										**5**
										Average loss from 2019 code cycle	**9**

2x2 and 2x4 Troffers with Static Color											
Lumen/Watt at CCT	**Number of Products**	**2700**	**3000**	**3500**	**4000**	**4500**	**5000**	**5700**	**6500**	**Average LPW**	**Baseline**
Manufacturer A	28			126	130					128	100
Manufacturer B	40		124	127	132					128	100
Manufacturer C	72		131	133	136		141			135	100
Manufacturer D	20		105	108	112					108	100
Manufacturer E	48		116	119	121		129			121	100
Total	**208**										

Source: Statewide CASE Team

Small Aperture 90 CRI Color Tuning

Small Aperture (4”/6”) 90 CRI Color Tuning vs 90 CRI Static		
Manufacturer	**Number of Products**	**Average Loss (%)**
Manufacturer A	45	26
Manufacturer B	12	9
Manufacturer C	58	18
Manufacturer D	12	32
Manufacturer E	21	24
Manufacturer F	18	12
Total	**166**	**19**
Average loss from 2019 code cycle		**34**

19%

Average efficacy loss between 90 CRI static and 90 CRI color tuning

- Efficacy difference between static and color tuning is shrinking

Source: Statewide CASE Team

Small Aperture 90 CRI Dim-to-Warm

Small Aperture (4”/6”) 90 CRI Dim-to-Warm vs 90 CRI Static		
Manufacturer	**Number of Products**	**Average Loss (%)**
Manufacturer A	45	14
Manufacturer B	12	5
Manufacturer C	58	7
Manufacturer D	12	27
Manufacturer E	21	2
Total	**148**	**14**
Average loss from 2019 Code cycle		**21**

14%

Average efficacy loss between 90 CRI static and 90 CRI dim-to-warm

- Moderate increase in efficacy of dim-to-warm compared to static

Source: Statewide CASE Team

LPD Summary

2019 LPD Update: ~300 GWh/yr

- Conversion to LED baseline

2022 LPD Proposal: % of 2019 savings but still significant

- Complex factors - no across-the-board change
  - Less efficacy loss: color tuning, high CRI
  - Revisit assumptions and changes to IES standards
  - Improved inverse Lumen Method model

Energy and Cost Impacts

- Assumptions & Methodology
- Preliminary Cost-effectiveness Research

Methodology for Energy Impacts Analysis

- Compare new calculated LPD versus 2019 LPD to yield kW/sf savings
  - 2019 Statewide CASE Team analysis for illuminance for general, task, ornamental, and wall washing and compare against current IES Handbook
  - Calculate W/sf based on recent high performance, high efficacy luminaires, good design practice and characterization of prototypical spaces.

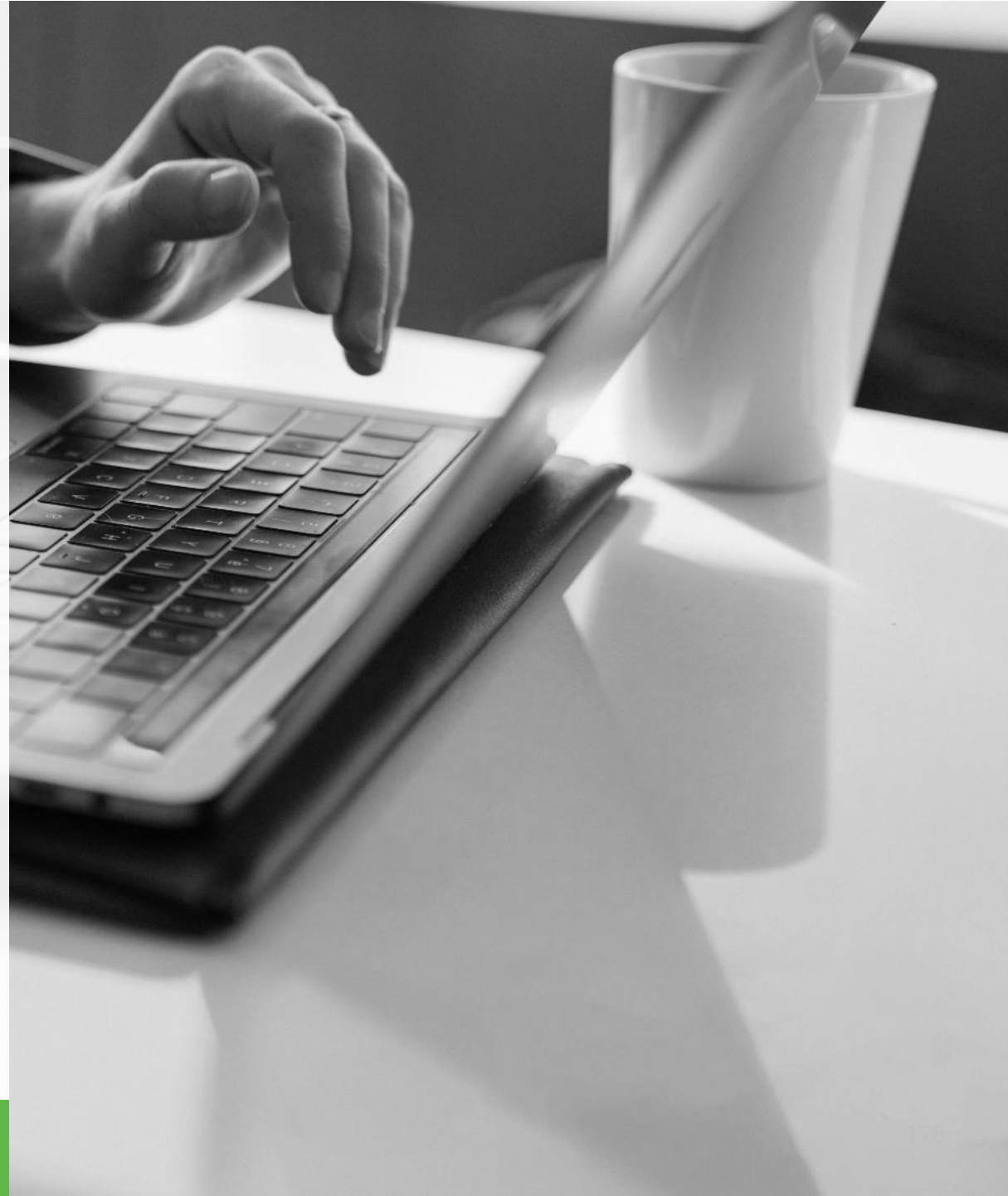
Tools Used	Inverse Lumen-Method Spreadsheet comparing design practices used to meet 2019 LPD requirements to proposed 2022 LPD requirements and detailed AGi32 models
Building Prototypes Used	Area category spaces with updated LPD requirements
Climate Zones Modeled	Not applicable – we are not looking at interaction with heating and cooling (second order effect)

Preliminary Cost-effectiveness Research

- **Research shows costs dropping across the board for LEDs:**
  - Price drop ranges from 2% to over 30%
  - Over 30 product types reviewed so far
  - All proposed LPDs likely to be cost effective

Proposed Language and Code Language Clean-up

- Section 130.0
- Section 130.1
- Section 140.6



Draft Code Change Language Updates

- **Updated** draft code language for this submeasure is available in the **resources tab.**

- Section 130.0(c)2: remove 50W per socket requirement
  - Justification: outdated requirement for legacy lighting
- Section 130.1(c)7B: remove exception for metal halide luminaires
  - Justification: outdated exception for legacy lighting
  - **Does it make sense to remove exception for metal halide luminaires?**
  - **Is this exception needed for retrofits?**

Draft Code Change Language Updates *(continued)*

- Table 130.1-A: remove rows for fluorescent, incandescent, HID, and induction lighting
  - Justification: outdated requirements for legacy lighting
  - **Does it make sense to remove these rows?**

Draft Code Change Language Updates *(continued)*

- Section 140.6(a)3: clarify that exceptions are only for Adjusted Indoor Lighting power
  - Current language suggests exempted areas are exempted for all Part 6 requirements
- Table 140.6-C: updated "Open Plan Office" to office > xxx square feet
  - Removing open plan office and defining small, medium, and large office space in square feet
  - > xxx sf will be aligned with Large Office Small Zone Occupancy Controls proposal
- Table 140.6-C: Primary Function areas reordered so easier to find. More alphabetical. Kitchen placed near dining. Large groupings (aged eye, healthcare and sports lighting) at end of table

Thank You

Questions?

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CALIFORNIA ENERGY CODES & STANDARDS
A STATEWIDE UTILITY PROGRAM

We want to hear from you!

+ Stakeholder meeting feedback informs utility-sponsored CASE Reports.
+ Draft CASE Reports for today's topics will be published in **April 2020**.

*Comments will be considered as they are received. Stakeholders are invited to submit feedback on today's presentation, and the Draft CASE Report to help shape the **Final** CASE Report submitted to the Energy Commission.*

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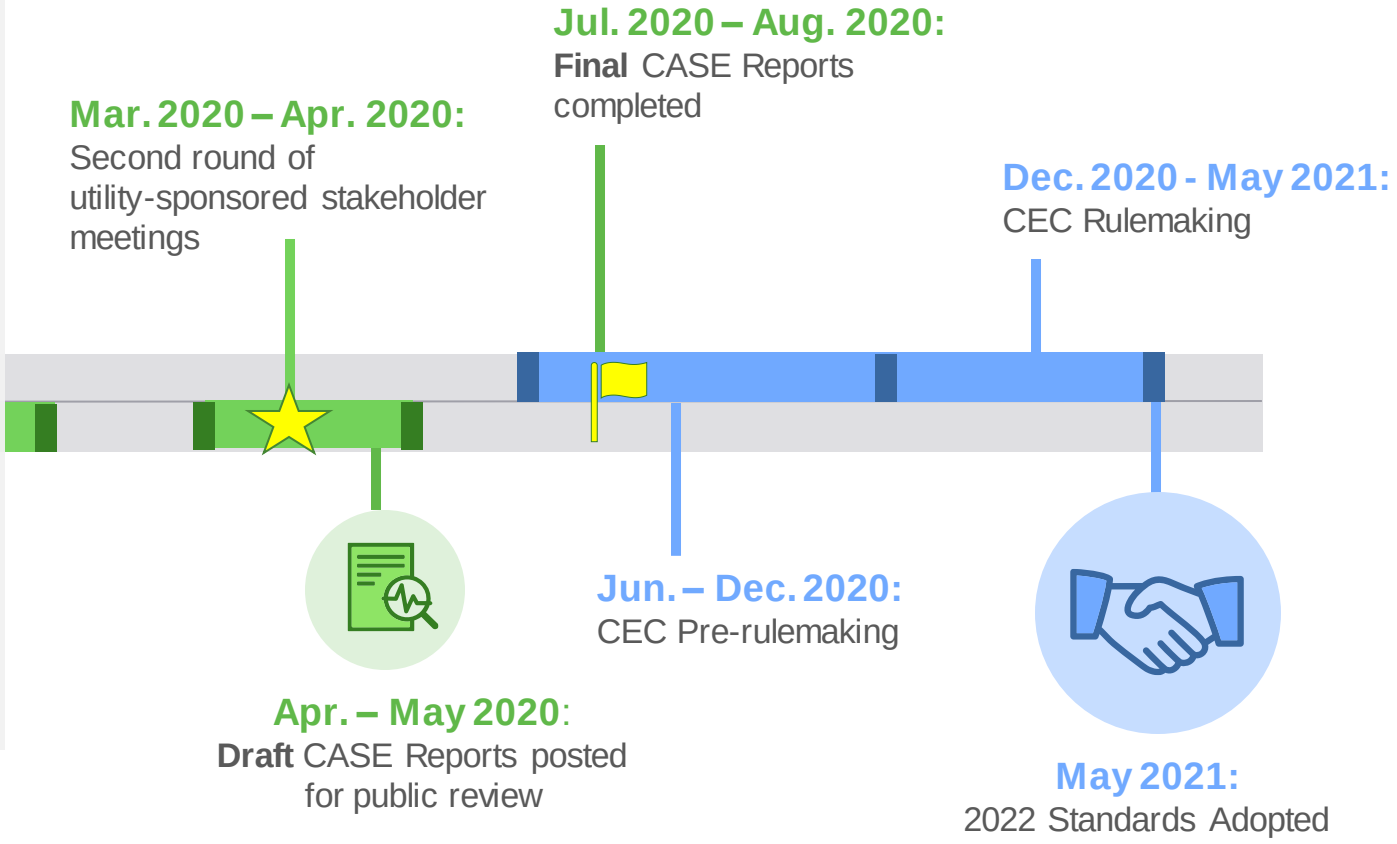

More information on pre-rulemaking for the 2022 Energy Code at https://www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards/2022-building-energy-efficiency

Upcoming Meetings

Meeting Topic	Building Type	Date
Lighting	NR/MF	Tuesday, March 3, 2020
Single Family Whole Building	SF	Thursday, March 5, 2020
Nonresidential and Single Family HVAC Part 1: Data Centers, Boilers, Air Distribution, Variable Capacity	NR/SF	Thursday, March 12, 2020
Water Heating and Multifamily All Electric Package	MF	Tuesday, March 17, 2020
Single Family Grid Integration	SF	Thursday, March 19, 2020
Multifamily HVAC and Envelope	MF	Thursday, March 26, 2020
Covered Processes Part 1: Refrigeration System Opportunities	NR	Thursday, April 2, 2020
Nonresidential HVAC and Envelope Part 2: Reduced Infiltration, HVAC Controls (Air Efficiency, DOAS)	NR	Tuesday, April 14, 2020
Covered Processes Part 2: Controlled Environmental Horticulture	NR	Thursday, April 16, 2020
Nonresidential Envelope Part 1: High Performance Envelope	NR	Thursday, April 23, 2020

Thank you for your participation today

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Please complete the closing polls below

Appendix A: Demand Responsive Lighting

Code impacts and reference language

Draft Code Change Language

2019 Reference Appendices, NA7.6.3 DR Controls Acceptance Tests

(b) Full output test

1. Using the manual switches/dimmers in each space, set the lighting system to full output. Note that the lighting in areas with photocontrols or occupancy/vacancy sensors may be at less than full output, or may be off.
2. Take one illuminance measurement at each location, using an illuminance meter.
3. Simulate a demand response condition using the demand responsive control.
4. Take one illuminance measurement at each location with the electric lighting system in the demand response condition.
5. Calculate the area-weighted average reduction in illuminance in the demand response condition, compared with the full output condition. The area-weighted reduction must be at least 15% but must not reduce the combined illuminance from electric light and daylight to less than 50% of the design illuminance in any individual space.

Illuminance Measurement Test

Current Measurement Test

(b) Full output test

1. Using the manual switches/dimmers in each space, set the lighting system to full output. Note that the lighting in areas with photocontrols or occupancy/vacancy sensors may be at less than full output, or may be off.
2. Take one electric current measurement for each selected circuit.
3. Simulate a demand response condition using the demand responsive control.
4. Take one illuminance measurement at each location with the electric lighting system in the demand response condition.
5. Add together all the circuit currents, and calculate the reduction in current in the demand response condition, compared with the full output condition. The combined reduction must be at least 15% but must not reduce the output of any individual circuit by more than 50%.

Draft Code Change Language

NRCC-LIT-E – Indoor Lighting Certificate of Compliance

C. COMPLIANCE RESULTS

Table Instructions: If any cell on this table says "DOES NOT COMPLY" or "COMPLIES with Exceptional Conditions" refer to Table D. for guidance.

Lighting in conditioned and unconditioned spaces must not be combined for compliance per §140.6(b)1.	**Allowed Lighting Power per §140.6(b) (Watts)**							**Adjusted Lighting Power per §140.6(a) (Watts)**				**Compliance Results**
	01	02	03	04		05		06	07		08	09
	Complete Building §140.6(c)1	Area Category §140.6(c)2	Area Category Additional §140.6(c)2G (+)	Tailored §140.6(c)3 (+)	=	**Total Allowed** (Watts)		Total Designed (Watts)	Adjustments PAF Control Credits §140.6(a)2 (-)	=	**Total Adjusted** (Watts) *Includes Adjustments	**05 Must be ≥ 08** §140.6
	(See Table I)	(See Table I)	(See Table J)	(See Table K)				(See Table F)	(See Table P)			
Conditioned:					=					=		COMPLIES
Unconditioned:					=					=		COMPLIES

Appendix B: Daylighting

Energy Savings Results: Small Office in all Climate Zones Dimming to OFF