

CODES AND STANDARDS ENHANCEMENT INITIATIVE (CASE)

PG&E Comments on 15 Day Proposed Changes to Nonresidential Lighting Retrofit Requirements in 2016 Title 24 Standards

Nonresidential Lighting Retrofits

2016 CALIFORNIA BUILDING ENERGY EFFICIENCY STANDARDS

April 24, 2015

Docket #:15-BSTD-01 2016 Building Standards Update

California Energy Commission

DOCKETED

15-BSTD-01

TN # 75654

APR 24 2015

This report was prepared by PG&E's Statewide Codes and Standards Program that is funded, in part, by California utility customers under the auspices of the California Public Utilities Commission.

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Executive Summary and Recommendations

The Pacific Gas and Electric Company (PG&E), as a California Investor Owned Utility serving over 9 million customers, understands the concerns of the lighting retrofit industry about the applicability of the CEC's current lighting efficiency codes to retrofit work. Since PG&E is authorized by the California Public Utilities Commission to operate both demand side management codes and standards advocacy and incentive programs, it is also in a unique position to analyze the impacts of changes to the code that might be made to accommodate the industry's concerns.

The following report analyzes the energy savings impacts of changes currently being considered by the CEC. It estimates that the proposed reduction in stringency would result in changed code requirements that allow retrofit lighting energy consumption to be 253 GWh/yr higher for each year's retrofit construction activity as compared to the current energy code. At the end of a three year code cycle, we expect the allowed retrofit energy consumption to be 759 GWh/yr higher than the current code.

In comparison, CEC staff is proposing four residential energy efficiency measures for inclusion into the 2016 Title 24 standards with an estimated savings of 127.3 GWh/yr and 9.3 Million therms and ten nonresidential measures with an estimated savings of 127.6 GWh/yr of electricity and 3.2 Million therms of natural gas. Total statewide savings for new proposed measures is 255.0 GWh/yr and 12.5 Million therms.

In effect, the proposed lighting retrofit changes would increase electricity consumption enough to offset all of the electricity savings from both residential and nonresidential measures proposed for 2016. Using a 3 to 1 source energy multiplier, the proposed nonresidential source energy savings are 16 Million therms, and the proposed nonresidential source energy savings losses due to the retrofit lighting proposal are 26 Million therms.

As a matter of public policy, process, and precedent, PG&E recommends that the Commission not make any changes to the current codes that would result in a loss of savings. Such changes may not merit a negative environmental impact declaration and may not allow the CEC to continue to make the required determination to the US Department of Energy that their energy efficiency standards for commercial buildings are at least as stringent as the ASHRAE 90.1 standards. The ASHRAE Standard 90.1-2010 significantly increased stringency by requiring that retrofitted systems where more than 10% of the lighting is retrofitted comply with lighting power density and a limited number of automatic control requirements.

Background to the 2013 Lighting Retrofit Requirements

Prior to the 2013 standards, the requirements for indoor lighting retrofits were fairly straightforward: when adding, replacing or removing and reinstalling luminaires more than 50% of the existing luminaires, the LPD requirements applied to the space. When altering lighting wiring systems, all the mandatory lighting control requirements applied.

The 2013 Title 24 standards for new nonresidential construction essentially required dimming controls for all spaces with LPD's higher than 0.5 W/sf and required dimming controls for daylighting. Also warehouses, library stacks, corridors, stairwells and parking garages were required to have partial off occupancy controls.

The ASHRAE 90.1-2010 standards required that all lighting retrofits of more than 10% of the existing lighting load meet the LPD requirements for the space with the altered lighting and the automatic shut-off requirements. Similar requirements applied to outdoor lighting retrofits where more than 10% of the connected lighting load is altered and controls requirements include controls to shut off lighting during the day and between midnight and 6 am. The ASHRAE standard not only applied to replacing luminaires but also when the ballast and lamps are replaced.

2013 Lighting Retrofit Requirements

Where more than 10% of the number of luminaires in a given room were moved, replaced or added, the retrofit section of 2013 Title 24 required both a maximum power allowance but also a wide array of lighting controls requirements including the requirements for multi-level controllable (i.e. dimmable) lighting. If the alteration resulted in an installed lighting wattage that was less than 85% of the area category LPD then the controls requirements were waived for multi-level dimming, daylighting and demand response.

Similar requirements also applied to "Luminaire Modifications-in-Place," replacing the components of a luminaire without removing it, or a one-to-one replacement of luminaires. The only difference is that the requirements did not apply until 40 or more luminaires on a floor of building were modified in such a manner. This led to the "*39 luminaire retrofit project*" so as not to trigger code.

The overall estimate of savings from the 2013 retrofit lighting requirements was around 445 GWh/yr for each year's retrofit activity. This is based on the assumption used in the CEC's impact analysis that, on average, all lighting systems are upgraded every 15 years.

Prior to the 2013 Title 24 standards, the outdoor lighting requirements were similar to the indoor lighting requirements. If more than 50% of the existing outdoor lighting luminaires were replaced or the installed wattage was increased, then the altered lighting system would have to meet the lighting power allowance for outdoor lighting. New for the 2013 standards was the requirement that when more than 10% of the luminaires were replaced or the wattage increased, the replaced light fixtures shall be controlled. This lower threshold for outdoor lighting controls was applied as it is common practice and cost-effective to place the daylight sensing and occupancy controls right on the replaced luminaire and the cost of adding or replacing a time clock relatively small.

Impact of 2013 Title 24 on the Lighting Retrofit Programs

Prior to the effective date of the 2013 standards on July 1, 2014, the lighting retrofit community was experiencing a downturn in fortunes due to increasing federal appliance regulation baselines. Though the federal general service fluorescent lamp standard has left a little leeway for some T-12 lamps (high CRI or high efficacy) T-12 lamps are rapidly being squeezed out of the market with NEEA predicting that sales of fluorescent lamps are dropping to less than 4% of the total market sales by 2013 (the turquoise and orange portions at the top of the bars in Figure 1). With fewer companies still using T-12 lamps and with an industry standard practice of converting the few remaining T-12 systems to T-8 lamps, less energy savings are possible from high performance T-8 retrofits as compared to standard T-8 baselines.

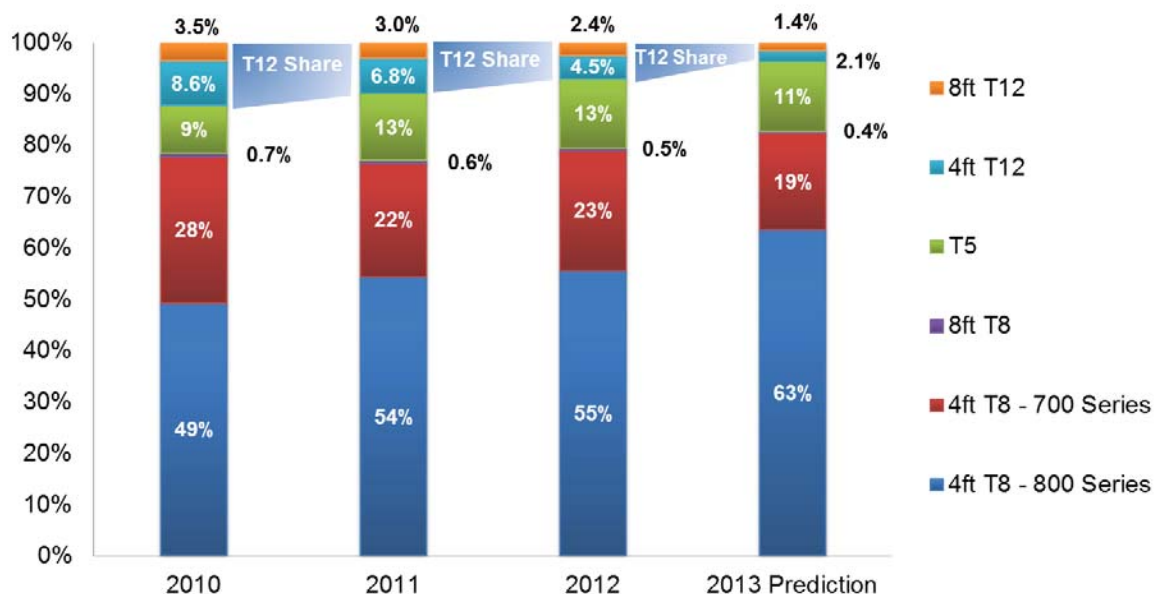


Figure 1: Declining Share of T-12 Lamps (NEEA NR Lighting Characterization 2010-12¹)

In this context of declining lighting retrofit opportunities, and incentives, the 2013 Title 24 codes had the following impacts:

- Projects that were treated as maintenance before were now subject to: permits, filing compliance data, complying with LPD and controls requirements
- Some cities were requiring plans being drawn to support the compliance documentation
- Controls requirements were triggering certified acceptance tests by CLCATTs (California Lighting Acceptance Test Technicians) with added costs and limited availability in some parts of the state
- Payment contingent on jobs having completed permits were also delaying payment

The actual impact of the 2013 Title lighting alteration requirements is evaluated by comparing lighting incentive program savings before and after July 1, 2014, when the 2013 Title 24 took effect. Figure 2 shows quarterly energy savings from PG&E nonresidential lighting alteration programs. These savings

¹ http://www.bpa.gov/EE/Utility/research-archive/Documents/Northwest_NonRes_Lighting_Market_Characterization.pdf

data do not indicate any reduction starting from the third quarter of 2015. Instead, it even shows obvious increase compared to the same period in 2013. Therefore, there is no negative impact by the 2013 Title 24 on nonresidential lighting alteration program savings.

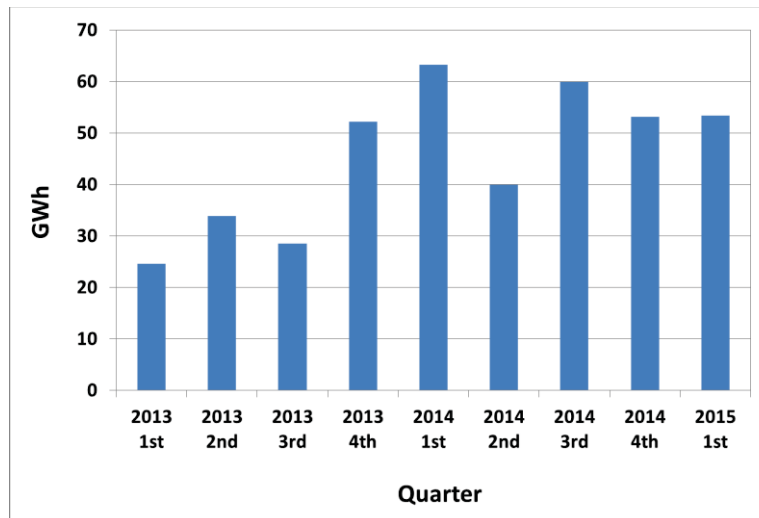


Figure 2 PG&E Nonresidential Lighting Retrofit Incentive Program Savings

CEC Lighting Retrofits Code Change Proposal for 2016 Title 24

In response to a number of comments from third party lighting retrofit contractors, the CEC staff published a 45 day code language that in some cases rolled back requirements to pre-2008 Title 24 code levels. Since that time, there have been some modifications to the initial proposal. The description below reflects the 20th version of a CEC staff interior lighting retrofit proposal and the 15th version of a similar outdoor lighting retrofit proposal for the 2016 standards. The description below indicates what has changed for indoor lighting retrofits.

- Luminaire Alterations
 - In addition to the requirements for the 2013 standards, an alternate path is available for luminaire replacements which does not require the calculation of an LPD as long as the total rated power of the newly added luminaires are 20% less than the rated power of the luminaires they replace. The control requirements for this path are also much reduced, only a time clock or other automatic shut off control is required instead of the full array of controls (including daylight controls) required for the other path.
- Component modifications
 - Unlike the 2013 standards which required meeting the LPD requirements and had control requirements that were essentially identical to the luminaire alteration requirements, the new proposal has two less stringent paths
 1. Meet the LPD requirement and install an area control by the door.
 2. Alternatively if the luminaire modification results in a total 20% reduction in the rated power of the existing luminaires, no controls are required.
- Wiring alterations
 - Wiring alterations no longer require: multi-level controls, demand responsive controls, daylighting controls under 25 luminaires, or bi-level occupancy controls for warehouses aisles, library stacks, hallway or stairwells or in parking garages.

Table 1 summarizes the LPD requirements and control requirements for each path allowed under the CEC's version 20 of the proposed 15 day language for the 2016 Title 24 standards and the similar compliance paths under the existing 2013 Title 24 standards. What is readily observable is that the CEC's proposal requires substantially less controls and the expected primary paths of compliance, shown in bolded font, additionally do not require compliance with LPD's.

Some of the changes in the 2016 proposals are welcomed. In particular, not requiring a separate area switch for display and ornamental lighting versus general lighting [§130.1(a)4] makes a lot of sense when wiring is not altered. Similarly, not requiring dimming or bi-level controls for areas where bi-level motion sensor or daylighting is not called for also makes good sense. We also recognize that bi-level occupancy controls for retrofitted hallways and corridors [§130.1(c)6C and §130.1(c)7A] is difficult as part of a retrofit as these spaces often have hard ceilings and the wattage of individual luminaires is often very low.

Table 1: Comparison of Lighting Retrofit Requirements between 2016 CEC Proposal and 2013 Title 24

	140.6	LPD	area switch	area switch	not override cntrls	separate switch display	dimming	bi-level switching	auto-shut-off either	auto-shut-off, separate display	countdown switches	timeclock timed override	holiday feature time clock	occ sensor only - class, conf rm	motion partial off: warehouse	motion partial off: library	motion partial off: corridor, stair	motion partial off hotel corridors	motion partial off garage	guestroom key card/occ sensor	auto daylighting controls - indoor	auto daylighting parking garage	demand response > 10,000 sf
	140.6		130.1(a)1	130.1(a)2	130.1(a)3	130.1(a)4	130.1(b)	Multi-level	130.1(c)1A-C	130.1(c)1D	130.1(c)2	130.1(c)3	130.1(c)4	130.1(c)5	130.1(c)6A	130.1(c)6B	130.1(c)6C	130.1(c)7A	130.1(c)7B	130.1(c)8	130.1(d)2	130.1(d)3	130.1(e)
2016 Proposal (v20)																							
Entire Luminaire 141.0(b)2li	> 85% <100%	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	120 W	60 W	Y
Entire Luminaire 141.0(b)2li	< 85%	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NR	NR	
Entire Luminaire 141.0(b)2lii: 20% less power than existing	NA								Y			Y	Y						Y		NR	NR	
Component Modification 141.0(b)2J	<100%	Y	Y	Y	Y	Y	Y	Y													NR	NR	
Component Modif Exception 2: 20% less power than existing	NA																				NR	NR	
Wiring Alterations 140.1(b)2K	<100%	Y	Y	Y	Y	Y	Y	Y	Y			Y	Y								25 L 1,250+ W	25 L 1,250 W	
2013 Standard																							
Luminaire Alterations 140.1(b)2lii	> 85% <100%	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	120 W	60 W	
Luminaire Alterations 140.1(b)2lii	< 85%	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NR	NR	
Luminaire Alterations 140.1(b)2lii Increase wattage	<100%	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	120 W	60 W	Y
Luminaire Mod-in-place and 1 for 1 replacement 140.1(b)2liii	> 85% <100%	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	120 W	60 W	
Luminaire Mod-in-place and 1 for 1 replacement 140.1(b)2liii	< 85%	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NR	NR	
Wiring Alterations 140.1(b)2liv	NA	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	120 W	60 W	Y

Energy Impacts of CEC Code Change Proposal

The CEC proposed changes will significantly reduce the fraction of lighting alteration floor areas to be regulated by the Title 24. Calculations of the reduction in stringency of the 2016 lighting alterations requirements versus those in the 2013 standards is detailed in *Appendix 1: Calculation Methodology of Net Energy Impacts from 2016 Lighting Alterations Proposal*. As shown in Table 2, the lost savings from the proposed changes to the alterations requirements are approximately 253 GWh/yr.

Table 2 Reduction of Annual Energy Savings (GWh/year) due to the Proposed 2016 Title 24 Lighting Alteration Requirements

Lighting Alteration Category	Section 140.6 LPD	Section 130.1(a) Area Controls	Section 130.1(b) Multi-level Controls	Section 130.1(c) Shut-off Controls	Section 130.1(d) Daylighting Controls
1a. Entire Luminaire Alteration. Section 141.0(b)2I i. > 85% LPD	0	0	0	0	0
1b. Entire Luminaire Alteration. Section 141.0(b)2I i. < 85% LPD	0	-3	0	0	0
1c. Entire Luminaire Alteration. Section 141.0(b)2I ii.	-6	-4	0	-57	-39
2a. Luminaire Comp. Modification. Section 141.0(b)2J: <20% power reduction	0	0	0	-6	-5
2b. Luminaire Comp. Modification. Exception 2: >20% power reduction	-6	-5	0	-68	-42
3. Lighting Wiring Alteration.	0	0	0	-5	-6
4. Other No wiring change, and <20% entire luminaire alteration, and < 40 luminaire Comp. modification	-1	0	0	-1	-1
Sub-Total	-12	-12	0	-137	-91
Total Energy Impact Reduction	-253 GWh/year				

Energy savings for the new controls and LPD requirements in the 2013 standards are based on the CEC 2013 Title 24 Impact Study and relevant 2013 Title 24 CASE studies, including Daylighting, Indoor Lighting Controls, Indoor Lighting-Retail, Control of Egress Lighting, Automated Lighting Controls and Switching Requirements in Multifamily and Hotel Corridors, Lighting in Warehouses and Libraries. Energy savings for the increase in scope of alterations are based on the 2013 Title 24 Lighting Alterations and Modifications in Place CASE study.² The unit savings in the various CASE studies are expanded to

² Reports for these CASE studies can be found from the CEC website on 2013 Title 24 rulemaking (<http://www.energy.ca.gov/title24/2013standards/rulemaking/>).

statewide totals by making use of the assumptions embedded in the CEC 2013 Title 24 Impact Study which estimates that 489 Million sf/yr of floor area are receiving lighting alterations each year.³ The reduced energy code savings estimates associated with lighting alterations for the 2016 code cycle use the same assumptions but correspondingly reduce the scope of coverage and reduced requirements associated with what the CEC staff have proposed in the 45-day language for the 2016 Title 24 upgrade. This proposal for 2016 excludes a wide range of currently regulated lighting alteration projects from future code regulation.

The proposed 2016 Title 24 would significantly reduce energy savings by the 2013 Title 24 lighting alteration requirements, especially lighting control requirements, as shown in Table 2. About 36% of the energy savings loss, approximately 91 GWh/year, arises from removing requirements for daylighting controls [Section 130.1(d) daylighting]. The removal of the requirement for bi-level occupancy controls in warehouses [Section 130.1(c)6A], is expected to increase statewide energy consumption by 44 GWh/yr.

Table 3: Estimate of Energy Savings from 2016 Title 24 CASE topics for one year's construction activity

CASE Study Name	CEC Measure ID	Annual Energy Savings	
		Electricity (GWh/yr)	Natural Gas (Million therms/yr)
High Performance Attics / Ducts in Conditioned Spaces (HPA/DCS)	2016-RES-ENV1-F	34.3	1.7
Residential High Performance Walls and QII	2016-RES-ENV2-F	14.2	4.5
Residential Lighting	2016-RES-LTG1-F	85.0	-
Residential HVAC Field Verification and Diagnostics	2016-RES-HVAC1-F	-	-
Instantaneous Water Heaters	2016-RES-DHW1-F	-6.2	3.2
Nonresidential Economizer Modifications	2016-NR-HVAC1-F	-	-
Nonresidential Indoor Lighting Power LPDs	2016-NR-LTG1-F	24.0	-
Nonresidential Lighting Controls: Partial-On OccSensors	2016-NR-LTG2-F	14.0	-
Outdoor Lighting LPA	2016-NR-LTG3-F	44.3	-
Nonresidential Opaque Envelope	2016-NR-ENV1-F	14.3	1.7
ASHRAE - HVAC and WH Equipment Efficiency	2016-NR-ASHRAE1-F	10.0	-
ASHRAE - DDC controls	2016-NR-ASHRAE2-F	10.9	1.3
ASHRAE: Elevator and Lighting and Ventilation	2016-NR-ASHRAE2-F	3.7	-
ASHRAE - Escalator and Moving Walkways	2016-NR-ASHRAE2-F	0.9	-
ASHRAE - Door Switch Controls	2016-NR-ASHRAE2-F	1.4	0.2
Nonresidential Outdoor Lighting Controls	2016-NR-LTG4-F	4.2	-
Nonresidential Thermally Driven Cooling*	2016-NR-HVAC2-F	-	-
Nonres Lighting Controls: Clarification and Controls Credit	2016-NR-LTG-5-F	-	-
Nonresidential Minimum Skylight Area*	NR-ENV-2-D	7.7	0.0
Total		255.0	12.5
Residential Subtotal of Savings		127.3	9.3
Nonresidential Subtotal of Savings		127.6	3.2

* Error fix, no credit applied

³ Assuming lighting systems are altered on average once every 15 years and California nonresidential building stock is 7.3 Billion square feet. See p. 25 *Impact Analysis: California's 2013 Building Energy Efficiency Standards* <http://www.energy.ca.gov/2013publications/CEC-400-2013-008/CEC-400-2013-008.pdf>

The total savings reduction caused by the proposed 45-day language on lighting alterations is about 253 GWh/year. As itemized in Table 3, the total statewide energy savings from all fourteen of the 2016 Title 24 CASE studies are about 255 GWh/year. Therefore, the net energy savings from the proposed 2016 Title 24 is 2 GWh. This means that the proposed 2016 Title 24, if adopted, would have a very small impact on the building energy use in California, as almost all savings from the 15 new measures are offset by the lost savings associated with proposed reduction in stringency for lighting retrofits.

If one only considered the nonresidential portion of the standards, the net impact would be 127.6 GWh - 253 GWh = - 125 GWh. The net impact is 125 GWh/yr of greater energy consumption for commercial buildings as compared to making no changes to the 2013 Title 24 nonresidential building energy efficiency standards.

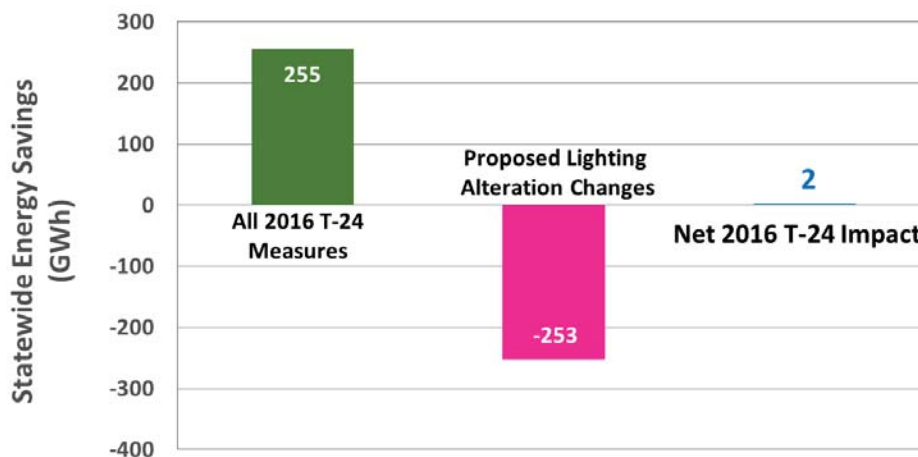


Figure 3 Total Energy Impact of the Proposed 2016 Title 24

Are Paper Losses Real?

The CPUC has been assessing actual energy savings achieved by California energy efficiency regulations (Title 20 appliance and Title 24 building energy efficiency standards) through its evaluation of IOU Codes and Programs (C&S). For building standards evaluation, CPUC evaluation collected market data to estimate the construction volumes affected by newly adopted standards and measured compliance rates of building samples. The recent CPUC 2010-12 C&S program evaluation provided the impact of 2008 Title 24 nonresidential lighting alteration requirements. Table 169 and 170 in the Appendix document of the evaluation report⁴ provides the following verified annual energy savings and lighting alteration floor areas:

⁴ Statewide Codes and Standards Program Impact Evaluation Report For Program Years 2010-2012, August 2014, CALMAC ID CPU0070.03

Table 4 CPUC Verified Energy Savings from 2008 Title 24 Lighting Alteration Requirements

	Annual Energy Savings (GWh/year)	Affected Lighting Alteration Floor Area (million sq. ft./year)
Lighting Alteration Using Complete Building Method	118	123
Lighting Alteration Using Area Category Method	64.5	185
Total	183	308

The evaluation sampled 75 lighting alteration projects in different types of nonresidential buildings throughout California to conduct Title 24 compliance assessment. The evaluation team specifically sampled projects that did not participate in utilities' incentive programs, so the evaluation results truly reflect market response to the Title 24 regulation. Field survey and energy use analysis indicated that compliance rates were high, as shown below based on data in table 184 and 185 in the Appendix document of the evaluation report.

Table 5 CPUC Verified Compliance Rates of 2008 Title 24 Lighting Alteration Requirements

Compliance rate – based on number of projects meeting Title 24	83%
Compliance rate – based on overall lighting energy performance	107%

The CPUC's C&S program evaluation results clearly indicate that Title 24 lighting alteration requirements have been successfully implemented in the state to generate real energy savings.

Appendix 1: Calculation Methodology of Net Energy Impacts from 2016 Lighting Alterations Proposal

Table 6 below provides estimated market shares of lighting alteration categories defined in the CEC proposed 2016 Title 24 45-day language. While the 2013 Title 24 covers 82% of lighting alteration floor areas, the CEC proposed 2016 Title 24 would only regulate about 56% of lighting alteration floor areas, which is a 26% reduction.

Table 6 Market Share of Lighting Alteration Types

Lighting Alteration Category (Based on the Proposed 45-day Language)	Estimated Market Share	Regulated by 2013 Title 24	Regulated by 2016 Title 24
1a. Entire Luminaire Alteration. Section 141.0(b)2I i. > 85% LPD Likely have wiring alterations	5%	Yes	Yes
1b. Entire Luminaire Alteration. Section 141.0(b)2I i. < 85% LPD Likely have wiring alterations	20%	Yes	Yes
1c. Entire Luminaire Alteration. Section 141.0(b)2I ii.	25%	Yes	Partial
2a. Luminaire Comp. Modification. Section 141.0(b)2J: <20% power reduction	3%	Yes	Partial
2b. Luminaire Comp. Modification. Exception 2: >20% power reduction	27%	Yes	No
3. Lighting Wiring Alteration. <20% entire luminaire alteration, and < 40 luminaire component modification	5%	Yes	Yes
4. Other <20% entire luminaire alteration, and < 40 luminaire component modification, and No wiring alterations	15%	Partial	No
Total Market Fraction	100%	86%	58%

The reductions in floor areas receiving lighting alterations that are subject to control requirements are even larger, between 39% to 79%, as shown in Table 7. Similarly, Table 8 provides detailed estimation of fractions of altered floor areas subject to (lighting power density (LPD) and different lighting control requirements.

Table 7 Estimated Fractions of Lighting Alterations Subject to LPD and Lighting Controls Requirements

	Section 140.6 LPD	Section 130.1(a) Area Controls	Section 130.1(b) Multi-level Controls	Section 130.1(c) Shut-off Controls	Section 130.1(d) Daylighting Controls
Proposed 2016 Title 24	58%	13%	10%	46%	6%
2013 Title 24	86%	86%	86%	86%	65%
Difference	-28%	-73%	-76%	-39%	-59%

Table 8 2016 CEC Proposal: Estimated Fraction of Lighting Alterations Subject to LPD and Lighting Controls Requirements

Lighting Alteration Category	Section 140.6 LPD	Section 130.1(a) Area Controls	Section 130.1(b) Multi-level Controls	Section 130.1(c) Shut-off Controls	Section 130.1(d) Daylighting Controls
1a. Entire Luminaire Alteration. Section 141.0(b)2I i. > 85% LPD Likely have wiring alterations	5%	5%	5%	5%	5.0%
1b. Entire Luminaire Alteration. Section 141.0(b)2I i. < 85% LPD Likely have wiring alterations	20%			20.0%	
1c. Entire Luminaire Alteration. Section 141.0(b)2I ii.	23%			18.8%	
2a. Luminaire Comp. Modification. Section 141.0(b)2J: <20% power reduction	3%	3%			
2b. Luminaire Comp. Modification. Exception 2: >20% power reduction	24%				
3. Lighting Wiring Alteration. <20% entire luminaire alteration, & < 40 luminaire component mod.	5.0%	5.0%	5.0%	2.5%	1.25%
4. Other <20% entire luminaire alteration, & < 40 luminaire component mod, & No wiring alterations					

Appendix 2: CEC Staff Lighting Retrofit Proposal for 2016 Title 24

(Version 20 for indoor lighting alterations and version 15 for outdoor lighting alterations)

I. **Entire Luminaire Alterations.** Entire luminaire alterations shall meet the following requirements:

- i. For each enclosed space, alterations that include adding entire luminaires or removing and reinstalling a total of 20 percent or more of the existing luminaires, or that include adding, removing, or replacing walls or ceilings resulting in redesign of the lighting system, shall meet the lighting power allowance in Section 140.6, and the altered luminaires shall meet the applicable requirements in TABLE 141.0-E.
- ii. For alterations where existing luminaires are replaced with new luminaires, the replacement luminaires shall have at least 20 percent lower rated power consumption compared to the original luminaires; and in spaces other than corridors and stairways, or spaces operating 24 hours per day, 365 days per year, shall be equipped with automatic shut-off controls complying with Sections 130.1(c)1A through C, 130.1(c)3, 130.1(c)4, and 130.1(c)7B.

EXCEPTION 1 to Section 141.0(b)2I. Alteration of portable luminaires, luminaires affixed to moveable partitions, or lighting excluded as specified in Section 140.6(a)3.

EXCEPTION 2 to Section 141.0(b)2I. In an enclosed space where only one luminaire is replaced or reinstalled.

EXCEPTION 3 to Section 141.0(b)2I. Alterations that would directly cause the disturbance of asbestos, unless the alterations are made in conjunction with asbestos abatement.

EXCEPTION 2 to Section 141.0(b)2. Acceptance testing requirements of Section 130.4 are not required for alterations where 20 or fewer controls are added.

J. **Luminaire Component Modifications.** Where 40 or more existing luminaires are modified on any single floor of a building, the following modifications shall meet the lighting power allowance in Section 140.6, comply with Subsections 130.1(a)1, 2, and 3, and shall not prevent or disable the operation of any multi-level, shut-off, or daylighting controls installed to control the luminaires:

- i. Replacing the ballasts or drivers and the associated lamps in the luminaire; or
- ii. Permanently changing the light source of the luminaire; or
- iii. Changing the optical system of the luminaire.

Lamp replacements alone and ballast replacements alone shall not be considered a modification of the luminaire provided that the replacement lamps or ballasts are installed and powered without modifying the luminaire.

EXCEPTION 1 to Section 141.0(b)2J. Modification of portable luminaires, luminaires affixed to moveable partitions, or lighting excluded by Section 140.6(a)3.

EXCEPTION 2 to Section 141.0(b)2J. Replacement of luminaire components where the modified luminaires have at least 20 percent lower power consumption compared to the original luminaires.

EXCEPTION 3 to Section 141.0(b)2J. Modifications that would directly cause the disturbance of asbestos, unless the modifications are made in conjunction with asbestos abatement.

K. **Lighting Wiring Alterations.** For each enclosed space, wiring alterations that add a circuit feeding luminaires; that replace, modify, or relocate wiring between a switch or panelboard and luminaires; or that replace lighting control panels, panelboards, or branch circuit wiring; shall:

- i. meet the lighting power allowance in Section 140.6;
- ii. meet the requirements in Sections 130.1(a)1, 2, and 3, 130.1(c)1A through C, 130.1(c)3, and 130.1(c)4;

- iii. for each enclosed space, be wired to create a minimum of one step between 30-70 percent of lighting power; and
- iv. for each enclosed space where wiring alterations include 25 or more luminaires that are located within the primary sidelit daylight zone and the skylit daylight zone, meet the requirements of 130.1(d).

Note: Alterations that include adding, removing, or replacing walls or ceilings resulting in redesign of the lighting system shall meet the requirements of Table 141.0-E.

EXCEPTION 1 to Section 141.0(b)2K. Modifications strictly limited to addition of lighting controls.

EXCEPTION 2 to Section 141.0(b)2K. Alterations that would directly cause the disturbance of asbestos, unless the alterations are made in conjunction with asbestos abatement.

L. Alterations to existing outdoor lighting systems in a lighting application listed in TABLE 140.7-A or 140.7-B shall meet the applicable requirements of Sections 130.0, 130.2(a), 130.2(b), and 130.4, and:

- i. In alterations that increase the connected lighting load, the added or altered luminaires shall meet the applicable requirements of Section 130.2(c) and the requirements of Section 140.7 for general hardscape lighting or for the specific lighting applications containing the alterations; and
- ii. In alterations that do not increase the connected lighting load, where the greater of 5 luminaires or 10 percent of the existing luminaires are replaced in a general hardscape or a specific lighting application:

In parking lots, outdoor sales lots, and sales canopies where the bottom of the luminaire is mounted 24 feet or less above the ground, the replacement luminaires shall comply with Section 130.2(c)1 AND Section 130.2(c)3;

For all other lighting applications and where the bottom of the luminaire is mounted greater than 24 feet above the ground, the replacement luminaires shall comply with Section 130.2(c)1 AND EITHER comply with Section 130.2(c)2 or be controlled by lighting control systems, including motion sensors, that automatically reduces lighting power by at least 40 percent in response to the area being vacated of occupants; and

- iii. In alterations that do not increase the connected lighting load, where the greater of 5 luminaires or 50 percent of the existing luminaires are replaced in general hardscape or a specific application, the replacement luminaires shall meet the requirements of subsection ii above and the requirements of Section 140.7 for general hardscape lighting or specific lighting applications containing the alterations.

EXCEPTION to Section 141.0(b)2Liii. Alterations where the replacement luminaires have at least 40 percent lower power consumption compared to the original luminaires are not required to comply with the lighting power allowances of Section 140.7.

EXCEPTION to Section 141.0(b)2L. Acceptance testing requirements of Section 130.4 are not required for alterations where controls are added to 20 or fewer luminaires.

TABLE 141.0-E Control Requirements for Lighting System Alterations

Control requirements that shall be met when 20% or more of existing luminaires in an enclosed space are altered	Resulting lighting power, compared to the lighting power allowance specified in Section 140.6(c)2	
	Lighting power is \leq 85% of allowance	Lighting power is > 85% to 100% of allowance
Section 130.1(a)1, 2, and 3 Area Controls	Yes	Yes
Section 130.1(b) Multi-Level Lighting Controls – only for alterations to general lighting of enclosed spaces 100 square feet or larger with a connected lighting load that exceeds 0.5 watts per square foot	For each enclosed space, minimum one step between 30-70 percent of lighting power regardless of luminaire type, or meet Section 130.1(b)	Yes
Section 130.1(c) Shut-Off Controls	Yes	Yes
Section 130.1(d) Automatic Daylight Controls	Not Required	Yes
Section 130.1(e) Demand Responsive Controls – only for alterations > 10,000 ft ² in a single building, and where the alteration changes the area of the space, or occupancy type of the space, or increases the lighting power	Not Required	Yes

Appendix 2: Lighting Retrofit Requirements in 2013 Title 24

- F. Spaces with lighting systems installed for the first time shall meet the requirements of Sections 110.9, 130.0, 130.1, 130.2, 130.4, 130.5, 140.3(c), 140.6, and 140.7.
- G. When the requirements of Section 130.1(d) are triggered by the addition of skylights to an existing building and the lighting system is not recircuited, the daylighting control need not meet the multi-level requirements in Section 130.1(d).
- H. New internally and externally illuminated signs shall meet the requirements of Sections 110.9, 130.3 and 140.8.
- I. For each enclosed space, alterations to existing indoor lighting shall meet the following requirements:

- i. **Luminaire Classification and Power** shall be determined in accordance with Section 130.0(c).

EXCEPTION to Section 141.0(b)2Ii: For only a Lighting System Alteration in accordance with Section 141.0(b)2Iii, or a Luminaire Modifications-in-Place in accordance with Section 141.0(b)2Iiii; an existing incandescent, fluorescent or HID luminaire may be modified and classified as a luminaire having a different number of, or type of light source(s), provided all of the following conditions are met:

- a. The luminaire has been previously used and is in an existing installation; and,
- b. The modified luminaire is listed with the different number or type of light source(s) under the installed conditions; and
- c. The different light source(s) is not an LED lamp, integrated or nonintegrated type, as defined by ANI/IES RP-16-2010; and
- d. The modified luminaire does not contain:
 - 1. Unused fluorescent or HID ballast(s); or
 - 2. Unused HID or fluorescent lamp sockets; or
 - 3. Sockets used only for lamp support; or
 - 4. Screw sockets of any kind or for any purpose; and
- e. The wattage of the modified luminaire shall be published in the manufacturer's catalog based on accredited testing lab reports.

- ii. **Lighting System Alterations** shall meet the applicable requirements in TABLE 141.0-E and the following:

- a. Lighting System Alterations include alterations where an existing lighting system is modified, luminaires are replaced, or luminaires are disconnected from the circuit, removed and reinstalled, whether in the same location or installed elsewhere.

EXCEPTION 1 to Section 141.0(b)2Iii: Alterations that qualify as a Luminaire Modification-in-Place.

EXCEPTION 2 to Section 141.0(b)2Iii: Portable luminaires, luminaires affixed to moveable partitions, and lighting excluded in accordance to Section 140.6(a)3.

- iii. **Luminaire Modifications-in-Place** shall meet the applicable requirements in TABLE 141.0-F and the following:

- a. To qualify as a Luminaire Modification-in-Place, luminaires shall only be modified by one or more of the following methods:
 - 1. Replacing lamps and ballasts with like type or quantity in a manner that preserves the original luminaire listing.

2. Changing the number or type of light source in a luminaire including: socket renewal, removal or relocation of sockets or lampholders, and/or related wiring internal to the luminaire including the addition of safety disconnecting devices.
 3. Changing the optical system of a luminaire in part or in whole.
 4. Replacement of whole luminaires one for one in which the only electrical modification involves disconnecting the existing luminaire and reconnecting the replacement luminaire.
- b. Luminaire Modifications-In-Place shall include only alterations to lighting system meeting the following conditions:
1. Luminaire Modifications-in-Place shall not be part of or the result of any general remodeling or renovation of the enclosed space in which they are located.
 2. Luminaire Modifications-in-Place shall not cause, be the result of, or involve any changes to the panelboard or branch circuit wiring, including line voltage switches, relays, contactors, dimmers and other control devices providing power to the lighting system.
- EXCEPTION to Section 141.0(b)2Iiii2.** Circuit modifications strictly limited to the addition of occupancy or vacancy sensors and class two lighting controls are permitted for Luminaire Modifications-in-Place

iv. **Lighting Wiring Alterations** shall meet the applicable requirements in Sections 110.9, 130.1, and 130.4.

- a. Lighting Wiring Alterations include the following:
1. Adding a circuit feeding luminaires.
 2. Modifying or relocating wiring to provide power to new or relocated luminaires.
 3. Replacing wiring between a switch or panelboard and luminaire(s).
 4. Replacing or installing a new panelboard feeding lighting systems.

EXCEPTION to Section 141.0(b)2Iiv. Lighting Wiring Alterations allowed for Luminaire Modifications-in-Place in accordance with Section 141.0(b)2Iiii.

- v. Any lighting alteration that increases the installed lighting power in an enclosed space shall meet the requirements of Sections 110.9, 130.0, 130.1, 130.4, 140.3(c) and 140.6.
- vi. Lighting Alterations and Luminaire Modifications-in-Place shall not exceed the lighting power allowance in Section 140.6.
- vii. The following indoor lighting alterations are not required to comply with the lighting requirements in Title 24, Part 6:
- a. Replacement in kind of parts of an existing luminaire that include only new lamps, lamp holders, or lenses, when replacement of those parts is not a Luminaire-Modification-in-Place in accordance with Section 141.0(b)2Iiii.
 - b. Lighting Alterations directly caused by the disturbance of asbestos.

EXCEPTION to Section 141.0(b)2Iviib: Lighting alterations made in conjunction with asbestos abatement shall comply with the applicable requirements in Section 141.0(b)2I.

J. Alterations to existing outdoor lighting systems shall meet the following requirements:

- i. Alterations that increase the connected lighting load in a lighting application listed in TABLE 140.7-A or 140.7-B shall meet the applicable requirements of Sections 130.0, 130.2, 130.4, and 140.7; and

- ii. In alterations that replace 10 percent or more of the luminaires in a lighting application listed in TABLE 140.7-A or 140.7-B, the altered luminaires shall meet the applicable requirements of Sections 130.0, 130.2 and 130.4; and
- iii. In alterations that replace more than 50 percent of the luminaires in a lighting application listed in TABLE 140.7-A or 140.7-B, the lighting in that application shall meet the applicable requirements of Sections 130.0, 130.2, 130.4 and 140.7.

TABLE 141.0-E Requirements for Luminaire Alterations

Quantity of existing affected luminaires per Enclosed Space ¹	Resulting Lighting Power for Each Enclosed Space	Applicable Mandatory Control Provisions for Each Enclosed Space	Multi-level Lighting Control Requirements for Each Altered Luminaire
Alterations that do not change the area of the enclosed space or the space type			
Sum total < 10% of existing luminaires	Existing lighting power is permitted	Existing provisions are permitted	Existing controls are permitted
Sum total ≥ 10% of existing luminaires	≤ 85% of allowed lighting power per Section 140.6 Area Category Method	§130.1(a), (c)	Two level lighting control ² or §130.1(b)
	> 85% of allowed lighting power per Section 140.6 Area Category Method	§130.1(a), (c), (d) ³	§130.1(b)
Alterations that change the area of the enclosed space or the space type or increase the lighting power in the enclosed space			
Any number	Comply with Section 140.6	§130.0(d) ³ §130.1(a), (c), (d) ³ , (e)	§130.1(b)
<p>1. Affected luminaires include any luminaire that is changed, replaced, removed, relocated; or, connected to, altered or revised wiring, except as permitted by EXCEPTIONS 1 and 2 to Section 141.0(b)2iii:</p> <p>2. Two level lighting control shall have at least one control step between 30 percent and 70 percent of design lighting power in a manner providing reasonably uniform illuminations</p> <p>3. Daylight controls in accordance with Section 130.0(d) are required only for luminaires that are altered.</p>			

TABLE 141.0-F-Requirements for Luminaire Modifications-in-Place

For compliance with this Table, building space is defined as any of the following:			
<ol style="list-style-type: none"> 1. A complete single story building 2. A complete floor of a multifloor building 3. The entire space in a building of a single tenant under a single lease 4. All of the common, not leasable space in single building 			
Quantity of affected luminaires per Building Space per annum	Resulting Lighting Power per Each Enclosed Space Where ≥ 10% of Existing Luminaires are Luminaire Modifications-in-Place	Applicable mandatory control provisions for each enclosed space ¹	Applicable multi-level lighting control requirements for each modified luminaire ²
Sum total < 40 Luminaire Modifications-in-Place	Existing lighting power is permitted	Existing provisions are permitted	Existing controls are permitted
Sum total ≥ 40 Luminaire Modifications-in-Place	≤ 85% of allowed lighting power per Section 140.6 Area Category Method	§130.1(a), (c)	Two level lighting control ³ Or §130.1(b)
	> 85% of allowed lighting power per Section 140.6 Area Category Method	§130.0(d) ⁴ §130.1(a), (c), (d) ⁴	§130.1(b)
<ol style="list-style-type: none"> 1. Control requirements only apply to enclosed spaces for which there are Luminaire Modifications-in-Place. 2. Multi-level controls are required only for luminaires for which there are Luminaire Modifications-in-Place. 3. Two level lighting control shall have at least one control step between 30 percent and 70 percent of design lighting power in a manner providing reasonably uniform illuminations. 4. Daylight controls in accordance with Section 130.0(d) are required only for luminaires that are modified-in-place. 			

Appendix 3: Lighting Alteration Requirements in 2008 Title 24

- F. Spaces with lighting systems installed for the first time shall meet the requirements of Sections 119, 130, 131, 132, 134, 143(c), 146, and 147; and
- G. When the requirements of Section 131(c)2B are triggered by the addition of skylights to an existing building and the lighting system is not re-circuited, the daylighting control need not meet the multi-level requirements in Section 131(c)2Diii.
- H. New internally and externally illuminated signs shall meet the requirements of Sections 119, 133 and 148.
- I. Alterations to existing indoor lighting systems shall meet the following requirements:
 - 1. Alterations that increase the connected lighting load, replace, or remove and re-install a total of 50 percent or more of the luminaires in an enclosed space, shall meet the requirements of Sections 130 and 146; and
 - 2. The following wiring alterations shall meet the requirements of Sections 119, 131, and 134:
 - i. Where new or moved wiring is being installed to serve added or moved luminaires; or
 - ii. Where conductor wiring from the panel or from a light switch to the luminaires is being replaced, or
 - iii. Where a lighting panel is installed or relocated.
 - 3. For an alteration where an existing enclosed space is subdivided into two or more spaces, the new enclosed spaces shall meet the requirements of Sections 131(a) and (d); and
 - 4. Alterations that have less than 0.5 watts per square foot and increase the existing lighting power density to 0.5 watts per square foot or greater shall meet the requirements of Sections 119, 130, 131, 134, 143(c), and 146.
- J. Alterations to existing outdoor lighting systems that for any lighting application increase the connected lighting load or replace more than 50 percent of the luminaires shall meet the requirements of Section 147; and