Staff Analysis of M. Niels Engineering Report, submitted with IBEW Lighting Alteration Comments.

Executive Summary:

The IBEW comment letter relies on a report by M. Niels Engineering to raise two main questions:

- do multi-level controls meeting the 2013 minimum requirements (manual dimmers and bi-level controls) save energy beyond that saved by the automatic shutoff controls (including both occupant sensors and automatic time controls) included in the 2016 requirements, and
- does a 35% power reduction (compared to the lighting installed before the retrofit) save more or less energy than meeting the 2016 lighting power densities (LPDs)?

Staff carefully analyzed the M. Niels report to determine if there were issues of concern raised by this analysis.

Multi-Level Controls

The Energy Commission's carefully designed 2016 Standards maintain strong requirements for the most effective lighting controls while still avoiding new wiring having to be pulled. The vast majority of energy savings provided by lighting controls are accomplished by automatic shutoff and occupant sensor controls, and requirements for these controls are maintained by the 2016 Standards.

In each of the cases where the M. Niels report raises a potential issue, staff has consistently found the issue to be caused by an error in the M. Niels report. For example, the M. Niels report erroneously uses a different baseline to assert higher energy savings for multi-level lighting in the 2013 Standards. The 2013 Standards provide five options for complying with multi-level controls: dimming controls, lumen maintenance, tuning, automatic daylighting controls, and demand responsive controls. To claim high energy savings for multi-level controls, IBEW analysis assumes "institutional tuning" as the basis of multi-level controls, however institutional tuning devices are uncommon and relatively expensive. A more appropriate option is to use "manual dimming', which is the least expensive control option and is often required to be installed regardless of the multi-level requirement; the energy savings of manual dimming controls are a fraction of the savings associated with tuning controls. Staff analysis more appropriately assumes "manual dimming" as the appropriate option for complying with the multi-level control, which results in negligible additional savings beyond the controls already required by the 15-day language.

Additionally, the report alleges that the Energy Commission decision to not continue to require "bi-level switching" will result in a major loss of energy savings. But since bi-level switching has been a requirement for newly constructed buildings since 1988, the vast majority of buildings are already equipped with bi-level switching, so little savings is lost by not requiring those

existing lighting systems that are so old that they missed the 1988 Standards to pull new wiring to upgrade to bi-level switching. Bi-level switching, like

Power Reduction

The Energy Commission and IOUs have shown that the 35% existing luminaire power reduction option saves energy for the population of building types throughout the state and for retrofitted lighting systems of the whole range of ages in California. The M. Niels report, on the other hand, "cherry picks" a small subset of "worst case" buildings (only three building types and only lighting systems older than 16 years) to conclude that the 35% existing power reduction alternative saves less energy than meeting the 2016 Standards lighting power allowances. This cherry picking is egregious since IBEW on record states that lighting systems are typically retrofitted every 10 to 15 years, and know that for retail buildings, lighting systems are typically upgraded at least every 7 years.

Staff has reviewed the points raised by the M. Niels report and referred to in IBEW's comment letter, and staff's findings for each point are explained below. Statements from the M. Niels report are in brown.

A. Presumed Lost Savings from Elimination of Multi-Level Control Requirements.

The M. Niels report states the following:

The Lighting Alteration Savings Analysis incorrectly assumes that the elimination of multi-level control requirements will not result in any energy saving losses beyond what is lost from the elimination of daylighting control requirements. Multilevel controls, however, also save energy by enabling task tuning, manual dimming/switching, and multiple levels of scheduled dimming. The CASE study on multilevel controls conducted to support the 2013 Standards identifies specific energy savings from multilevel control task tuning *that are not associated with other control strategies*. Based on the Lighting Alteration Savings Analysis that supported the savings from 2013 Code lighting measures, the proposed elimination of multi-level control requirements will result in 148 GWh per year of lost energy savings that were not accounted for in the analysis.

Staff's analysis of the report finds the following:

This comment has several erroneous assumptions embedded in it. Lighting controls include an assortment of different control devices –controls include manual on-off switches, automatic timers, occupancy sensors, daylighting controls, and controls, such as dimmers, that allow for multiple lighting levels.

Section 130.1(b) of the 2013 Standards, which contains the multi-level lighting requirements evaluated by the M. Niels report, requires that luminaires have a specified number of control steps, meet uniformity requirements, and be controlled by one of five methods: dimming controls, lumen maintenance, tuning, automatic daylighting controls, or demand responsive controls. The control steps and uniformity requirements are specified in Table 130.1-A, which specifies that for some luminaire types continuous dimming is required, and for all other luminaire types controlled dimming, stepped dimming, or alternate switching is required.

Section 130.1(a)2C requires dimmable luminaires to be controlled by manual dimmer controls. This means that all luminaires meeting the uniformity requirements of Section 130.1(b) through continuous or stepped dimming are required by Section 130.1(a)2C to have dimming controls; such controls also satisfy the control requirement of Section 130.1(b). Even when not required, dimming controls are the least costly of the five allowed control methods, and thus are found by staff to be the most common method of complying with multi-level requirements.

The report asserts that the Energy Commission's current proposal gives up significant savings compared to the current code, because it allows flexibility regarding multilevel controls. However, when these savings are calculated the report errs in the following ways:

1. It erroneously assumes that the energy savings from multi-level controls are equal to savings estimated to result from institutional tuning; in reality, under the 2013 Standards, the most common and least expensive strategy to meet the multi-level controls is "manual dimming" and not "tuning controls". This requirement to install a manual dimmer is an enabling technology that does not directly cause savings (i.e., no one is required to dim the lights).
2. It erroneously includes the contribution of daylighting controls that are captured separately in the original staff analysis, conflating the two control types and resulting in a double counting of this contribution.
3. It erroneously includes the contribution of bi-level occupant sensing controls already captured in the calculation of savings for occupant sensing controls.

Once the impact of shutoff controls, occupancy sensors, and daylighting controls are correctly separated from the savings estimate used in the report, and the ability to install "manual dimming" instead of "tuning controls" is correctly accounted for, the savings that can be correctly attributed to multi-level control requirements become negligible.

To explain, Section 130.1(b) of the 2013 Standards, which contains the multi-level lighting requirements evaluated by the M. Niels report, requires that luminaires have a specified number of control steps, meet uniformity requirements, and be controlled by one of five methods: dimming controls, lumen maintenance, tuning, automatic daylighting controls, or demand responsive controls. The control steps and uniformity requirements are specified in Table 130.1-A, which specifies that for some luminaire types continuous dimming is required, and for all other luminaire types controlled dimming, stepped dimming, or alternate switching is required.

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In addition, lighting alterations have an additional compliance option if the altered lighting uses no more than 85% of the Lighting Power Allowance calculated for the space. In these cases, builders have the option of installing a simple bi-level control (such as a bi-level switch) instead of meeting the control steps, uniformity, and control method requirements of Section 130.1(b). These controls sometimes support the partial-off occupant sensing specifications of Section 130.1(c) 6 and 7, though only Section 130.1(c)7B is specific in requiring a control step below 50% and above zero.

The reality is that requiring dimmable lighting paired with manual dimmer controls, or requiring bi-level switching, saves negligible energy in a nonresidential setting. Dimming and bi-level controls are comparable to area controls: they are enabling technologies that do not directly cause savings (i.e., no one is required to manually dim or partially turn off the lights), and are justified based on their typically low cost to install.

As a result staff finds that the loss in energy savings described by the report are due solely to an erroneous understanding of the Standards and erroneous calculation based on that misunderstanding, as tuning is not required in the 2013 standards and manual dimming does not provide the savings estimated for tuning in the CASE report cited by M. Niels. The only savings losses related to dimming is where dimming is used for daylight controls, which is already captured in the analysis as originally prepared by staff, or for bi-level occupancy sensing - which is also already captured in the energy savings analysis originally prepared by staff.

B. Weighted Average Lighting Power Density Calculations.

The M. Niels report states the following:

The Lighting Alteration Savings Analysis incorrectly assumes that lighting power requirements under the 2016 standards are an average of 20% lower than allowed under the 1998/2001 standards. Subsequent to this calculation the CEC prepared a more accurate weighted lighting power density (LPD) calculation based upon the percentage of total square footage of existing buildings represented by each occupancy type. (See Exhibit D.) Under this revised percentage, the CEC calculated that the average 2016 LPD savings over pre-2005 Code would be 27%, not 20%. However, the CEC failed to update this corrected average in the Lighting Alteration Savings Analysis. Changing the average 2016 LPD savings over vintage LPD savings from 20% to 27% would reduce energy savings by approximately 63 gigawatt hours per year. Even assuming that some percentage of lighting retrofits would meet 2005 Code LPD requirements, the additional lost energy savings would still amount to between 22 and 45 gigawatt hours per year.

Staff's analysis of the report finds the following:

The 27% weighted average 2016 LPD savings is calculated based on an implausible scenario: it would require that 100% of retrofitted lighting systems are 2001 and older lighting systems, no exceptions. This is not realistic, and is the result of erroneously ignoring the weighting applied to account for system vintage that is applied after the weighting to account for percentage of floor space: the 27% figure is the LPD savings calculated after the floor area weighting is applied but before the vintage weighting is applied. Applying the vintage weighting to this 27% results in the final 20% LPD savings figure present in the staff analysis.

This is important, as testimony and written comments by multiple stakeholders, including IBEW's letter, asserts that the average age of most lighting system retrofits are 10-15 years. The Energy Commission's analysis estimated that 45% of the retrofitted lighting systems fall under 2001 standards and before, 40% under 2005, 13% under 2008, and 2% under 2013. Weighting the savings from each vintage by these percentages results in the 20% savings used to calculate total LPD savings, as shown below:

Vintage	1998 and 2001	2005	2008	2013	2016	
Average 2016 LPD Savings Over Vintage LPDs	27%	17%	11%	3%	0%	
Fraction of vintage in retrofits	45%	40%	13%	2%		100%
				Weighted reduction		**20%**

Correctly applying both weights (floor area and vintage) results in the percent savings value used in the Lighting Alteration Savings Analysis.

C. Percentage of Existing Systems with Automatic Shutoff and Multi-Level Controls.

The M. Niels report states the following:

The Lighting Alteration Savings Analysis overestimates the fraction of existing lighting systems that already utilize automatic shutoff and multi-level lighting controls. The Analysis assumes there is no way to know how many existing systems use these controls and arbitrarily assumes a usage rate of 50%. This is incorrect, the California Appliance Saturation Survey issued by Itron on behalf of the CPUC in 2014, surveyed approximately 1400 commercial businesses on what types of lighting controls they had installed. Only about 10-30% of large businesses had some form of auto shutoff control and between 0% and 20% of all other businesses had these controls. Adjusting the number to 20% results in an additional 50 GWh per year of lost savings.

Staff's analysis of the report finds the following:

The M. Niels report is in error, as this energy savings would only be lost if automatic shutoff control requirements were removed from the requirements that apply to lighting alterations. This did not occur.

D. Rounding of a Reconciliation Factor.

The M. Niels report states the following:

The Lighting Alteration Savings Analysis improperly rounded down a reconciliation factor for determining the fraction of total commercial floor space applicable to the 2013 standards from 0.916 to 0.91. This rounding error results in about 0.5 GWh per year of lost savings.

Staff's analysis of the report finds the following:

There is no rounding error in the staff analysis: the M. Niels report is erroneous in identifying the source of the reconciliation factor used in the staff analysis. The value 0.91 (69% +22% = 91%) comes from the market survey results presented in Figure 4) Effect of Code Change by Lighting Section Required in the 2013 Title 24 Lighting Alterations and Modifications in Place CASE study, not based on the CBECS building size data.

E. Market Share Adjustments.

The M. Niels report states the following:

The Lighting Alteration Savings Analysis arbitrarily and without justification assumed the 2016 proposed standards would affect a 3% bigger market share than the 2013 Standards despite actually increasing the number of lighting retrofits that would be exempt from compliance with the standards. Removing this arbitrary market share assumption results in an additional 20.5 GWh per year of lost savings.

Staff's analysis of the report finds the following:
The M. Niels report errs in stating that the market share estimates are arbitrary. The estimated increase in affected market share is not arbitrary, and is based on the following changes reflected in the proposed 2016 Title 24 requirements:

- Under the proposed 2016 Title 24, the second path of entire luminaire alterations (Section 141.0(b)2I ii) is applicable to all entire luminaire alteration projects, except those altering no more than two luminaires. In comparison, the 2013 Title 24 entire luminaire alteration requirements are applicable to project altering more than 10% of the existing luminaires. The corresponding increase in affected market share was estimated to be 6.1%.
- For luminaire component modifications, the threshold for regulation is 70 luminaires under the proposed 2016 Title 24 and 40 luminaires under the 2013 Title 24. The corresponding reduction of affected market share is 2.9%.

Combining the above two changes, the net change in affected market share is 6.1% - 2.9% = 3.2%.

F1. Additional Factors that are Presumed to Reduce Energy Savings.

The M. Niels report states the following:

In addition to the issues described above, a number of additional factors that have not been taken into account in our calculations will further reduce energy savings from that required under the 2013 code. The potential lost energy savings from these factors should also be estimated and disclosed before the Commission considers approving this code change.

(1) Failure to Take into Account Disparate Effect on Different Function Areas.
The Lighting Alteration Savings Analysis fails to take into account that function area types whose LPD maximums have been reduced by more than 35% since the 1998/2001 code are much more likely to utilize the newly proposed 35% lighting power reduction compliance path than function areas whose LPD maximums have been reduced by less than 10% since the 1998/2001 code. Under the 2016 Code proposal, retrofits will have two options for avoiding multi-level, daylighting and demand response lighting control requirements: (1) installing alterations that use less than 85% of the LPD maximum or (2) reducing overall power consumption by 35%. Under the 2013 Code, only the 85% LPD option was available to avoid full lighting control requirements. Because building owners will most often select the option that is the easiest and cheapest to meet, not all function areas will select the 35% lighting power reduction compliance path at an equal rate. The rate that different function areas select the 35% lighting power reduction compliance path will have a significant effect on how much energy savings or losses will result from the adoption of this path.

For example, function areas such as office, retail and hotel occupancies (which collectively make up over 43% of the existing nonresidential building spaces) can reduce their power consumption by 35% from 1998/2001 code requirements and still not meet the 100% LPD requirement since the LPD requirement for each of these function areas has decreased by more than 35% since the 1998/2001 code. Accordingly, these function areas will use substantially more energy by following the 35% pathway than by following the 100% LPD path (with full controls) or the 85% LPD path (with partial controls) currently allowed under the 2013 code. Moreover, 35% power reduction path will be much easier to meet for these function areas than either of the other, more energy efficient, pathways.

Function areas such as commercial storage, theatre or gym occupancies, on the other hand, would be significantly more energy efficient under the 35% lighting reduction pathway because their maximum allowed LPDs are the same as the maximum LPDs allowed in pre-2005 vintage lighting systems. Accordingly, it would be much easier for these function areas to avoid advanced control requirements by using the 85% LPD path (requiring a 15% LPD reduction) than by using the 35% power reduction path.

The assumption in the Analysis that each function area will use the 35% power reduction path at an equal rate is not credible. Instead, function areas that will be less energy efficient under the 35% power reduction path are much more likely to use that path than function areas that would be more energy efficient under the 35% power reduction path. This likely disparity in the rate that function areas use the 35% power reduction path will result in further significant lost energy savings over what would occur in the 2013 code. The potential lost energy savings from this disparity needs to be estimated and disclosed before the Commission considers approving this code change.

Staff's analysis of the report finds the following:
As noted previously, the report is again focusing on cherry-picked "worst case scenarios" without the larger context. The assertions of the M. Niels report are based on an erroneous assumption that all lighting retrofits will be 2001 or older projects occurring solely in hotels, offices, and retail spaces.

This is simply not true, nor is it reasonable. In reality, lighting retrofit jobs include far more varied occupancies, such as schools, warehouses, restaurants, and convention centers among others, and as previously demonstrated, will include a significant share of lighting systems from other vintages besides 2001 standards, including from 2005 and 2008 standards.

The M. Niels report errs where it asserts that market share would be a direct function of energy savings (i.e, that the approach with the greatest efficiency savings will always be the approach with the greatest cost), and that the compliance path requiring the least energy savings would therefore always be preferred from a cost standpoint. The decision to engage in a lighting retrofit project is driven by cost effectiveness and payback period: given that greater energy savings provides greater cost savings in reduced energy bills, the decision is a cost-effectiveness decision driven by the cost of the alteration *relative to its benefit*. The assertion that the project providing the least benefit will always be chosen is straightforwardly erroneous.

To be clear, staff did not fail to account for function area types in their analysis, and the M. Niels report is also erroneous where it asserts that this is the case. The power reduction path addresses two specific costs that are independent from energy savings: the cost of running new wiring if it is needed to install bi-level or multi-level controls, and the cost of calculating lighting power

densities and allowances if there are spaces with non-rectangular geometry. These costs are independent of any energy or cost savings a project would realize, noting that an exchange of 2001-era fluorescent luminaires with 2016-era LEDs can, by itself, reduce power consumption by over 50% and carry a project past either compliance pathway's thresholds. Staff determined in their original analysis that the choice of pathway would therefore be driven by whether significant costs related to new wiring or LPD calculation existed, and estimated market share values for each pathway accordingly. Staff did not find that these conditions were necessarily more or less likely to occur for specific function areas, and for this reason determined that assigning per-function-area market share weights would not be appropriate.

F2. Verification and Enforcement.

The M. Niels report states the following:

The 35% power reduction path will also result in additional energy saving losses due to enforcement issues that are inherent with this approach. Verification and enforcement of the 35 percent reduction will be extremely difficult, because when a retrofit building permit is issued, the first site visit by an inspector is to inspect the rough installation, including any new wiring. At this stage of a construction project, the original lighting fixtures or components would already be gone so the baseline value of the existing luminaires could not be verified. This may lead to inaccurate or fraudulent estimates of the lighting power reduction since property owners and lighting contractors will have a strong economic incentive to claim that a 35 percent reduction has been achieved.

Staff's analysis of the report finds the following:

CALBO, representing the local building departments that are responsible for enforcing the Standards, have provided testimony indicating satisfaction with the proposed 15-day language. In fact, they claim that the enforcing the 35% luminaire power reduction is easier than enforcing the lighting power density (LPD) calculation in existing buildings.

F3. Scope of Existing Exemptions.

The M. Niels report states the following:

The 2013 Code provides a limited exemption from multi-level, daylighting and demand response control requirements for lighting alterations that result in an average lighting power density that is at least 85% less than the maximum watts per square feet allowed for the function area, and a complete exemption from any energy efficiency requirements where less than 10% of luminaires are altered – but these exemptions only apply if no walls or ceilings are moved and the occupancy type stays the same. As a result, most tenant improvement work is not eligible for this advanced control exemption. The 2016 proposal expands these exemptions to include all lighting alterations, including where the alteration moves walls or ceilings, or changes the occupancy type.

Staff's analysis of the report finds the following:

The M. Niels report misreads the proposed language and this interpretation is in error: the proposed language clearly requires lighting power density calculations and compliance with

Table 141.0-E (including multi-level controls) in alterations where walls and ceilings are moved or the lighting system is re-designed, per the text of Section 141.0(b)2I:

> I. **Entire Luminaire Alterations.** Entire luminaire alterations shall meet the following requirements:
>
> > i. For each enclosed space, alterations that consist of either (a) removing and reinstalling a total of 10 percent or more of the existing luminaires; or (b) replacing or adding entire luminaires; or (c) adding, removing, or replacing walls or ceilings along with any 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; or
> >
> > ii. For alterations where existing luminaires are replaced with new luminaires, and that do not include adding, removing, or replacing walls or ceilings along with redesign of the lighting system, all the replacement luminaires shall collectively have at least 35 percent lower rated power at full light output as compared to the existing luminaires being replaced, and shall meet the applicable requirements of Sections 130.1(a)1, 2, and 3, 130.1(c)1A through C, 130.1(c)2, 130.1(c)3, 130.1(c)4, 130.1(c)5, 130.1(c)6A, and for parking garages 130.1(c)7B.

Underline added.

F4. New Partial Exemption from Acceptance Test Requirements.

The M. Niels report states the following:

The proposed 2016 Code language also exempts indoor and outdoor lighting retrofits from current acceptance test requirements where controls are added to 20 or fewer luminaires. This exemption will further reduce energy savings from what would be achieved through compliance with 2013 Code requirements. Studies have shown that without acceptance testing, the actual energy savings achieved by the installation of lighting controls may be less than half of what would be achieved with acceptance testing. The lost energy savings from this proposed exemption should be calculated and disclosed before the Commission considers approving this code change.

The M. Niels report also states the following, on a later page:

B. New Partial Exemption from Acceptance Test Requirements

In addition to creating exemptions from current lighting control requirements, the proposed 2016 Code language also exempts indoor and outdoor lighting retrofits from current acceptance test requirements where controls are added to 20 or fewer luminaires. This exemption will further reduce energy savings from what would be achieved through compliance with 2013 Code requirements.

Acceptance testing, which has been required by Title 24 since 2005, is necessary to ensure that assumed paper energy savings translate to actual energy savings. Studies have found that the gap

between the expected energy efficiency savings of HVAC and lighting control installations and the energy savings actually realized when evaluated has been as much as 51% and 63%.[1] This gap is particularly prevalent with the installation of advanced lighting controls. An evaluation of Title 24 acceptance testing effectiveness found that automatic daylighting controls failed in 7 out of 7 tests, and occupancy sensors failed in 2 out of 3 tests. All of the failures were due to design, installation, and/or calibration issues that would not have been identified without acceptance testing.[2]

As these studies show, without acceptance testing, the actual energy savings achieved by the installation of lighting controls may be less than half of what would be achieved with acceptance testing. While these studies are limited in size, they represent the best available evidence on the impact of acceptance testing. The lost energy savings from this proposed exemption should be calculated and disclosed before the Commission considers approving this code change.

Staff's analysis of the report finds the following:
Acceptance testing saves energy when it catches issues missed during the installation and configuration of a lighting control system and prevents such issues from "losing" the energy savings that would otherwise be provided by the controls. Acceptance testing has a high fixed cost associated with it, which makes it prohibitively expensive for small projects involving a small number of controls, in particular given that small projects are unlikely to be complex enough to have more than a negligible risk of issues occurring and not being caught or to include a large enough number of controls for the per-control cost of testing to become cost effective. This Exception provides relief for very small projects that involves controlling 20 or fewer luminaires. Staff's analysis shows that the cost for acceptance testing for a single control is around $210 with relatively small incremental costs for testing additional controls at the same time: $290 for five controls, $350 for 10 controls, and $460 for 20 controls.

In addition, staff analyzed the three reports cited by the M. Niels report (the CPUC report, the report prepared by Al Lutz and Vishy Tirumalashett, and the report by Tyler et al.). Staff found that these reports did not support the statements for which they were cited, contrary to how they are discussed within the M. Niels report.

For example, the CPUC paper does not support the assertions made above. The paper reviewed is "Energy Efficiency Evaluation Report for the 2009 Bridge Funding Period" January 2011 Prepared by Energy Division and was posted on the web page cited. A search for the 51% and 63% figures cited in the M. Niels report was conducted through the entire paper and none was found outside of this *"Option 1.) Extrapolate findings from continued programs to determine net resource benefits for programs that did not receive full impact evaluation in 2009; 48% of kWh 51% of kW, and 9% of therm reported savings received this treatment."* (page 10) However, this is a broad discussion of the comparison of net to gross benefits, and includes issues such as free-ridership (program participants that would have conducted the measure anyway without utility

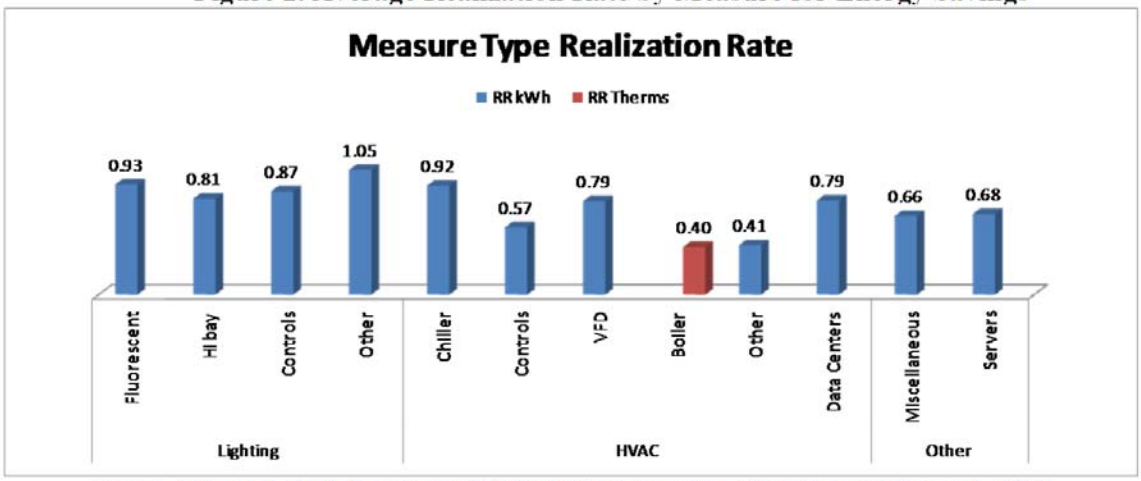
[1] See Energy Division, California Public Utilities Commission, *Energy Efficiency Evaluation Report for the 2009 Bridge Funding Period* (January 2011). http://www.cpuc.ca.gov/PUC/energy/Energy+Efficiency/EM+and+V/2009_Energy_Efficiency_Evaluation_Report.htm ; Lutz, Al and Vishy Tirumalashett, ACEEE Summer Study Proceedings, *Measure by Measure: the Real Reasons for Gaps in Claimed and Evaluated Savings* (2012), http://aceee.org/files/proceedings/2012/data/papers/0193-000134.pdf#page=1 .

[2] Tyler, Matthew, John Farley and Eliot Crowe. Evaluation of Title 24 Acceptance Testing Enforcement and Effectiveness. PECI, September 2011. http://www.cacx.org/PIER/documents/T24_Acceptance_Testing_Final_Report.pdf.

program intervention), measures that were not installed, inappropriate baselines that were used, and projects that may use more energy than predicted due to incorrect installation. Only one of these issues (incorrect installation) is potentially related to acceptance testing.

The report by Lutz and Tirumalashett supports the need for an exception from acceptance testing for small projects. Figure 2, copied here, indicates that lighting controls have a realization rate of 87% without acceptance testing. This means that actual savings were falling short of estimated savings by only 13% (or less than 1/6th of estimated savings). 13% can be substantial in a larger project, but will not be cost effective for small projects with high fixed overhead.

Figure 2. Average Realization Rate by Measure for Energy Savings



Source: ADM et al. 2010; Itron et al. 2010; SBW Consulting et al. 2010; Summit Blue et al., 2010

Staff spoke to the author of the Tyler et al. report, who said that the study was not a comprehensive investigation of the failure rate of lighting control systems. This study included only 2 buildings with automatic daylighting control systems; the root causes of the problems were daylighting design and/or installation errors, which were replicated in both buildings. All 7 automatic daylighting control systems failed, though these failures were associated with the daylight zone being too large.

The comment implies 2 out of 3 tests for occupancy sensing failed. This is not true. The following table, copied from the report, shows that only one test of occupancy sensors was performed.

Table 5: Acceptance Test Performed

Test ID	Form	Test Name	Times Performed
NA7.5.1.1	MECH-2A	Variable Volume Outdoor Air Acceptance	5
NA7.5.1.2	MECH-2A	Constant Volume Outdoor Air Acceptance	3
NA7.5.2	MECH-3A	Constant Volume, Single-Zone, Unitary AC and Heat Pump	5
NA7.5.3	MECH-4A	Air Distribution Systems	3
NA7.5.4	MECH-5A	Air Economizer Controls	8
NA7.5.6	MECH-7A	Supply Fan Variable Flow Controls	10
NA7.5.8	MECH-9A	Supply Water Temperature Reset Controls	2
NA7.5.9	MECH-10A	Hydronic System Variable Flow Controls	1
NA7.6.1	LTG-3A	Automatic Daylighting Controls Acceptance	7
NA7.6.2	LTG-2A	Occupancy Sensor Acceptance	1
NA7.6.3	LTG-2A	Manual Daylighting Controls Acceptance	1
NA7.6.4	LTG-2A	Automatic Time Switch Control Acceptance	1
NA7.7.2	OLTG-2A	Outdoor Lighting Shut-off Controls	1
Total tests performed			48

The small number of total tests performed in this study makes it worthless as a statistical representation of all buildings throughout all of California, and the M. Niels report errs where it uses it in this fashion.