

C-10: Reduce Exterior Lighting Allowances (C405.5)

Summary: More efficient LED fixtures can be applied to exterior lighting. This proposal reduces exterior lighting allowances by an average of about 4%. More efficient lighting sources can provide the same lighting output with less power input. When LPD is reduced, it results in a proportional lighting energy savings.

A comment review for DOE proposal C-10 was added on December 18, 2015.

Stakeholder Feedback: There were four public comments received for proposal C-10. Comments are summarized below, followed by a DOE review:

- One generally supportive comment suggested that exterior lighting controls should be incorporated more into outside lighting and questioned whether LEDs are cost-effective at this stage of the market.
Review: There are already exterior lighting control provisions in the IECC to reduce exterior grounds lighting (C405.2.5) during certain night hours. Exterior lighting with LEDs is common practice and has been cost justified.
- One comment requested information that changes in LPD allowances would still allow fluorescent and metal halide lamp types.
Review: An LPD allowance based solely on LEDs would be even lower, so a mix of other lamp types will be allowed by the proposals.
- One comment that off-peak electric prices should be used in the cost-effectiveness analysis.
Review: Many utilities do not provide "time of day" rates to all commercial customers and there is not a reliable single source for such price information. The established DOE methodology for cost-effectiveness uses national average rates as its basis. Further, the cost-effectiveness analysis shows that when lamp replacement costs are factored in, the LED fixtures have a lower life-cycle cost than existing HID fixtures; so the actual savings do not impact the cost-effectiveness conclusion. The change is anticipated to be cost-effective even with lower off-peak rates.
- One supportive comment requested that DOE's proposal remain aligned with ASHRAE Standard 90.1.
Review: This proposal is aligned with proposals to revise to 90.1 (addendum CG). The second public review of addendum CG to 90.1 made no changes in values and only a minor editorial change to an exception that does not exist in the IECC.

In response to these comments, DOE will submit proposal C-10 as originally posted.

== = IECC PROPOSAL:

Modify Table C405.5.2(2) as follows:

TABLE C405.5.2(2)
INDIVIDUAL LIGHTING POWER ALLOWANCES FOR BUILDING EXTERIORS

		LIGHTING ZONES			
		Zone 1	Zone 2	Zone 3	Zone 4
Base Site Allowance (Base allowance is usable in tradable or nontradable surfaces.)		500 <u>350</u> W	600 <u>400</u> W	750 <u>500</u> W	1300 <u>900</u> W
Tradable Surfaces (Lighting power densities for uncovered parking areas, building grounds, building entrances and exits, canopies and overhangs and outdoor sales areas are tradable.)	Uncovered Parking Areas				
	Parking areas and drives	0.04 <u>0.03</u> W/ft ²	0.06 <u>0.04</u> W/ft ²	0.10 <u>0.06</u> W/ft ²	0.13 <u>0.08</u> W/ft ²
	Building Grounds				
	Walkways/Ramps less than 10 ft wide	0.7 <u>0.5</u> W/linear foot	0.7 <u>0.5</u> W/linear foot	0.8 <u>0.6</u> W/linear foot	1.0 <u>0.7</u> W/linear foot
	Walkways/Ramps 10 ft wide or greater	0.14 <u>0.10</u> W/ft ²	0.14 <u>0.10</u> W/ft ²	0.16 <u>0.11</u> W/ft ²	0.2 <u>0.14</u> W/ft ²
	Plaza areas	0.75 <u>0.6</u> W/ft ²	1.0 <u>0.7</u> W/ft ²	1.0 <u>0.7</u> W/ft ²	1.0 <u>0.7</u> W/ft ²
	Special feature areas	0.15 <u>0.12</u> W/ft ²	0.15 <u>0.12</u> W/ft ²	0.2 <u>0.14</u> W/ft ²	0.3 <u>0.21</u> W/ft ²
	Building Entrances and Exits				
	<u>Pedestrian and vehicular entrances and exits</u> Main entries	20 <u>14</u> W/linear foot of opening W/lin ft of door width	20 <u>14</u> W/linear foot of opening W/lin ft of door width	30 <u>21</u> W/linear foot of opening W/lin ft of door width	30 <u>21</u> W/linear foot of opening W/lin ft of door width
	<u>Other doors</u>	20 W/lin ft of door width	20 W/lin ft of door width	20 W/lin ft of door width	20 W/lin ft of door width
	Entry canopies	0.25 <u>0.2</u> W/ft ²	0.25 <u>0.2</u> W/ft ²	0.4 <u>0.25</u> W/ft ²	0.4 <u>0.25</u> W/ft ²
	Sales Canopies				
	Free-standing and attached	0.6 <u>0.4</u> W/ft ²	0.6 <u>0.4</u> W/ft ²	0.8 <u>0.6</u> W/ft ²	1.0 <u>0.7</u> W/ft ²
	Outdoor Sales				
	Open areas (including vehicle sales lots)	0.25 <u>0.2</u> W/ft ²	0.25 <u>0.2</u> W/ft ²	0.5 <u>0.35</u> W/ft ²	0.7 <u>0.5</u> W/ft ²
	Street frontage for vehicle sales lots in addition to "open area" allowance	No allowance	10 <u>7</u> W/linear foot	10 <u>7</u> W/linear foot	30 <u>21</u> W/linear foot
	Non-tradable Surfaces (Lighting power density calculations for the following applications can be used only for the	Building facades	No allowance	0.075 W/ft ² of gross above-grade wall area	0.113 W/ft ² of gross above-grade wall area
	Automated teller machines (ATM) and night depositories	270 <u>135</u> W per location plus 90 <u>45</u> W per additional ATM per location	270 <u>135</u> W per location plus 90 <u>45</u> W per additional ATM per location	135W per location plus 45W per additional ATM per location	270 <u>135</u> W per location plus 90 <u>45</u> W per additional ATM per location

specific application and cannot be traded between surfaces or with other exterior lighting. The following allowances are in addition to any allowance otherwise permitted in the "Tradable Surfaces" section of this table.)	Uncovered entrances and gatehouse inspection stations at guarded facilities	0.75 0.5 W/ft ² of uncovered area (covered areas are included in the "Canopies and Overhangs" section of "Tradable Surfaces")	0.75 0.5 W/ft ² of uncovered area (covered areas are included in the "Canopies and Overhangs" section of "Tradable Surfaces")	0.75 0.5 W/ft ² of uncovered area (covered areas are included in the "Canopies and Overhangs" section of "Tradable Surfaces")	0.75 0.5 W/ft ² of uncovered area (covered areas are included in the "Canopies and Overhangs" section of "Tradable Surfaces")
	Uncovered loading areas for law enforcement, fire, ambulance, and other emergency service vehicles	0.5 0.35 W/ft ² of uncovered area (covered areas are included in the "Canopies and Overhangs" section of "Tradable Surfaces")	0.5 0.35 W/ft ² of uncovered area (covered areas are included in the "Canopies and Overhangs" section of "Tradable Surfaces")	0.5 0.35 W/ft ² of uncovered area (covered areas are included in the "Canopies and Overhangs" section of "Tradable Surfaces")	0.5 0.35 W/ft ² of uncovered area (covered areas are included in the "Canopies and Overhangs" section of "Tradable Surfaces")
	Drive-up windows/doors	400W 200W per drive-through			
	Parking near 24-hour retail entrances	800W 400W per main entry			

For SI: 1 foot = 304.8 mm, 1 watt per square foot =W/0.0929 m². W = watts.

Reason: This proposal modifies the exterior Lighting Power Allowances (LPA) by changing the basis for determining an energy effective and achievable power density from typical high-intensity discharge (HID) or fluorescent lamps to Light Emitting Diode (LED) technology, where practical. The LED technology basis was developed by directly comparing the efficacy of appropriate replacement LED products with the efficacy of comparable HID or fluorescent products. Direct comparison of market available products showed that a change from metal halide HID to LED technology could be achieved with an average reduction of 48% to 61% which translates to a potential revised LPA of 39% to 52% of the existing values. To ensure appropriate design capability in all applications, the maximum reduction factors were revised to provide typically 60% or more of the current LPAs. The reduction factors thus determined were applied to the applicable area type lighting power allowances to produce this revised LED-based set of LPAs.

Energy Savings: An analysis of energy impact for the stand-alone retail prototype shows that annual savings from the exterior lighting reduction in the proposal averages \$70 per parking area fixture, with a tight range ($\pm 0.3\%$) across all climate zones. More details are found in the cost-effectiveness analysis referenced in the cost impact section.

The U.S. Department of Energy (DOE) develops its proposals through a public process to ensure transparency, objectivity and consistency in DOE-proposed code changes. Energy savings and cost impacts are assessed based on established methods and reported for each proposal, as applicable. More information on the process utilized to develop the DOE proposals for the 2018 IECC can be found at:

<https://www.energycodes.gov/development/2018IECC>.

Cost Impact: The LED lamps for use in exterior light fixtures provide more lighting at a lower energy use. The incremental cost for parking lot lighting fixtures was found to be \$380; however, the LED lamp life is longer, avoiding multiple lamp replacement costs with the baseline HID fixtures. LED prices are expected to continue to decrease, making this technology increasingly cost-effective.

Cost-effectiveness: A study completed in 2014¹ for the U.S. Department of Veterans Affairs found that LED fixtures were cost-effective in all exterior applications. PNNL performed a cost-effectiveness analysis using

¹ John Jolly, and Theodore C. Moeller. "LED & Conventional Lighting Systems Comparison Study." GLHN Architects & Engineers, Inc. for the National Institute of Building Sciences and the Department of Veterans Affairs, May 2014. <http://www.cfm.va.gov/til/studies/LEDStudy.pdf>.

the established DOE methodology.² Results of the cost-effectiveness analysis showed that the savings-to-investment ratio (SIR) was infinite for typical retail establishments, as the present value of costs was negative due to a reduction in lamp replacement costs. A proposal is cost-effective when the SIR is greater than 1.0, indicating that the present value of savings is greater than the incremental cost. The complete cost-effectiveness analysis is available at: <https://www.energycodes.gov/development/2018IECC>.

² Hart, R., and Liu, B. (2015). *Methodology for Evaluating Cost-effectiveness of Commercial Energy Code Changes*. Pacific Northwest National Laboratories for U.S. Department of Energy; Energy Efficiency & Renewable Energy. PNNL-23923 Rev1. <https://www.energycodes.gov/development/commercial/methodology>.