MANDATORY MEASURES
OUTDOOR LIGHTING CONTROLS

(Reference: Sub-Chapter 4, Section 130.2)
Any alteration that increases the connected lighting load must meet all mandatory and prescriptive measures that are required.

Local government agencies may adopt and enforce energy standards for newly constructed buildings, additions, alterations, and repairs that exceed those of Title 24, Part 6, provided that the Energy Commission has reviewed and approved the local standards.
BACKLIGHT, UPLIGHT, AND GLARE (BUG) RATINGS

The BUG system is used to evaluate luminaire performance in relation to lighting trespass, sky glow, and high-angle brightness. This is necessary in order to reduce light pollution, which has a negative effect on people, wildlife and the surrounding environments.

**Backlight**

Backlight includes all illumination that is in the space between the ground and 80 degrees above ground. Backlighting causes light trespass, which occurs when light is cast in unwanted areas due to poor control.

**Uplight**

Uplight is defined as excess lighting directed into the night sky. This causes light pollution, also known as artificial sky glow.

**Glare**

Glare is any overlapping light between the uplight and backlight zones. It can be mildly offensive or hazardous and visually disabling.
Section 130.2 (b)

OUTDOOR LIGHTING
Outdoor luminaires using lamps or light sources rated **greater than 150 watts** must comply with uplight and glare limitations if they are in the following areas:

1. Parking lots and service stations
2. Building entrances
3. All canopies
4. Outdoor dining areas
5. All outdoor sales areas
LUMINAIRES THAT DO NOT NEED TO COMPLY WITH BUG

These limits do not apply to:

- Signs
- Building facades, public monuments, statues, and vertical surfaces of bridges
- Lighting required for health or safety
- Temporary lighting
- Replacement of pole-mounted luminaires in areas where all of the following apply:
  1. Connected lighting power is not increased
  2. No new wiring is being installed
  3. No additional poles are being added
  4. Spacing between poles is greater than six times the mounting height of the existing luminaires
BUG RATINGS AND REQUIREMENTS

BUG ratings are determined by the amount of light in each angular component per backlight, uplight, and glare. Each BUG zone has a maximum number of lumens that is allowed—called the maximum zonal lumen limit.

A list of BUG ratings and tables can be found on the IES website:

<table>
<thead>
<tr>
<th>TABLE 130.2-A: UPLIGHT RATINGS (MAXIMUM ZONAL LUMENS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Secondary Solid Angle</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>------------------------</td>
</tr>
<tr>
<td>Uplight High (UH)</td>
</tr>
<tr>
<td>100–180 degrees</td>
</tr>
<tr>
<td>Uplight Low (UL)</td>
</tr>
<tr>
<td>90–&lt;100 degrees</td>
</tr>
</tbody>
</table>
There are two major steps for exterior spaces to comply with Title 24:

1. **Meet all mandatory requirements**
   The mandatory requirements set forth required controls that must be installed and functionality requirements for exterior lighting systems.

2. **Meet all prescriptive or performance requirements**
   The prescriptive requirements set a maximum lighting power allowance for exterior spaces. A space complies with these requirements if the *actual* lighting power installed in the space is less than the *allowed* lighting power for that space.
MANDATORY REQUIREMENTS: ALL SPACES

1. Any outdoor luminaire that is capable of operating an incandescent lamp that uses more than 100 watts must be controlled by a motion sensor.

2. All outdoor lighting must be controlled by a photocontrol or astronomical time switch that turns off all lighting when daylight is available.

3. Outdoor lighting must be circuited and controlled independently from other electrical loads.
MANDATORY REQUIREMENTS: LUMINAires MOUNTED AT OR BELOW 24 FEET

Where the bottom of a luminaire is mounted at 24 feet above the ground or lower, the following automatic lighting controls are required:

1. A motion sensor or other control system that automatically reduces lighting power when no occupants are detected—at least 40%, but not more than 80%
2. Controls must automatically turn on lights when an area becomes occupied
3. No more than 1,500 watts of lighting power may be controlled together

The following luminaires are exempt:

1. Pole-mounted luminaires with a maximum rated power of 75 watts
2. Non-pole-mounted luminaires with a maximum rated power of 30 watts
3. Linear lighting with a maximum power of 4 watts per linear foot
MANDATORY REQUIREMENTS:
LUMINAIRES MOUNTED AT OR BELOW 24 FEET

These requirements do not apply to the following spaces:
1. Building facades, ornamental hardscape, and outdoor dining areas
2. Sales frontage, lots, and canopies
3. Any area listed in Section 140.7(a)
MANDATORY REQUIREMENTS:
LUMINAIRES MOUNTED AT OR BELOW 24 FEET

There are different requirements for specific spaces:

1. Sales frontage, lots, and canopies must have a part-night control or motion sensors with auto-on capability.
2. Building facades, ornamental hardscapes, and outdoor dining must have a part-night control, motion sensor, or centralized time-based lighting control.

A part-night control is a time or occupancy based lighting control that is programmed to reduce or turn off the lighting power to an outdoor luminaire for a portion of the night.
MANDATORY REQUIREMENTS:
LUMINAIRES MOUNTED AT OR BELOW 24 FEET

Wall Packs

If the bottom of the luminaire is mounted 24 feet above the ground or lower, wall packs > 30W must be controlled by a motion sensor that reduces lighting power by **at least 40% but not more than 80%**.
### CASE STUDY: CURFEW DIMMING AT CSU LONG BEACH

Curfew dimming reduced light output of the system to 75% for 10 hours of the night, resulting in 71% energy savings.

<table>
<thead>
<tr>
<th>TECHNOLOGY</th>
<th>SYSTEM SIZE (W)</th>
<th>ANNUAL ENERGY CONSUMPTION (kWh)</th>
<th>ANNUAL ENERGY COST</th>
<th>ANNUAL MAINTENANCE COST</th>
<th>TOTAL ANNUAL COST</th>
<th>LIFECYCLE ENERGY COST</th>
<th>LIFECYCLE MAINTENANCE COST</th>
<th>TOTAL LIFECYCLE COST</th>
<th>TOTAL LIFECYCLE COST FOR ALL FIXTURES</th>
</tr>
</thead>
<tbody>
<tr>
<td>MH</td>
<td>189</td>
<td>828</td>
<td>$124</td>
<td>$20</td>
<td>$144</td>
<td>$850</td>
<td>$140</td>
<td>$990</td>
<td>$2,971</td>
</tr>
<tr>
<td>CMH CURFEW DIMMING</td>
<td>51 (Low) 67 (High)</td>
<td>263</td>
<td>$39</td>
<td>$0</td>
<td>$39</td>
<td>$270</td>
<td>$0</td>
<td>$270</td>
<td>$810</td>
</tr>
<tr>
<td>SAVINGS</td>
<td></td>
<td>565</td>
<td>$85</td>
<td>$20</td>
<td>$105</td>
<td>$580</td>
<td>$140</td>
<td>$720</td>
<td>$2,161</td>
</tr>
</tbody>
</table>
CASE STUDY: WALL PACKS AT UC DAVIS

- UC Davis replaced 101 HPS and MH wall packs with adaptive LED
- Used WattStopper motion sensors and networked controls from Lumewave
- Retrofit cut energy consumption by 89%
- $76,000 in energy costs will be saved over the life of the new wall packs
LIGHTING ZONES

Lighting Zone 1: Government parks, recreation areas, wildlife preserves

*Ambient Illumination: Dark*

The local authority over the property will know if the property is a government designated park, recreation area, or wildlife preserve. If the park is within a rural or urban area, it can be considered a part of lighting zone 2 or 3.

Lighting Zone 2: Rural Areas

*Ambient Illumination: Low*

Rural areas include any population, housing, and territory that contain less than 2,500 people.
LIGHTING ZONES

Lighting Zone 3: Urban Areas

*Ambient Illumination: Medium*

An urban area is a densely settled core of census tracts that contain at least 2,500 people.

Lighting Zone 4: Special Use District

*Ambient Illumination: High*

This zone may be created by a local government through application to the California Energy Commission and is used for special area types that require a particularly high amount of light.
LIGHTING POWER ALLOWANCES

The allowed lighting power for a space is determined by measuring the area of the installation and multiplying by the lighting power allowance for that space.

The actual lighting power is the total watts of all non-exempt lighting systems (including ballast, driver, or transformer losses).

Photo: Cree
LIGHTING POWER ALLOWANCES

The following affect the allowed lighting power for a space:

- Size of the illuminated area
- Number of luminaires
- Mounting heights
- Layout

The **illuminated area** is any hardscape area within a square around each luminaire or pole, minus obstructions.

The size of this square is **10 times the luminaire mounting height**, with the luminaire in the middle of the square.
LIGHTING POWER ALLOWANCES

Area Wattage Allowances (AWA)
Determined for the total illuminated hardscape area.

Linear Wattage Allowances (LWA)
Determined for the total perimeter length of the hardscape. The total hardscape perimeter does not include areas that are not illuminated.

Initial Wattage Allowances (IWA)
May be used once per project site. The IWA provides additional wattage for small sites or for unusual hardscape geometries.

Table 0-8 (Table 140.7-A in the Standards) – General Hardscape Lighting Power Allowance

<table>
<thead>
<tr>
<th>Type of Power Allowance</th>
<th>Lighting Zone 1</th>
<th>Lighting Zone 2</th>
<th>Lighting Zone 3</th>
<th>Lighting Zone 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area Wattage Allowance (AWA)</td>
<td>0.035 W/ft²</td>
<td>0.045 W/ft²</td>
<td>0.090 W/ft²</td>
<td>0.115 W/ft²</td>
</tr>
<tr>
<td>Linear Wattage Allowance (LWA)</td>
<td>0.25 W/lf</td>
<td>0.45 W/lf</td>
<td>0.60 W/lf</td>
<td>0.85 W/lf</td>
</tr>
<tr>
<td>Initial Wattage Allowance (IWA)</td>
<td>340 W</td>
<td>510 W</td>
<td>770 W</td>
<td>1030 W</td>
</tr>
</tbody>
</table>
PLANTERS AND LANDSCAPE AREAS

LESS than 10 ft:
• Planters and small landscape areas are included within the general hardscape area as long as the width or length of the inclusion is less than 10 ft., and the inclusion is bordered on at least three sides.

GREATER than 10 ft.:
• Both width and length are excluded from the general hardscape area calculation
• Perimeter of these exclusions may be included in the linear wattage allowance (LWA) calculation