

LIGHTING SERVICES - APPLICATION, INNOVATION & INTEGRATION



NEEDS ASSESSMENT

- Site surveys
- Lighting system evaluations
- Workplace impact
- Better energy use and sustainability
- Operational efficiency improvements
- Financial metrics

SOLUTION DEVELOPMENT

- Cost benefit / savings analysis
- Lighting design (interior and exterior)
- Integrated controls and energy management
- Code-compliant designs

REBATE PROCESSING

- Rebate research and analysis
- Rebate-maximized designs
- Application processing and follow-through service
- Design Lights Consortium (DLC) listing confirmation

MATERIAL SELECTION & PROCUREMENT

- Vendor and product analysis vetting
- Volume purchasing agreements
- Procurement and shipment expediting

PROJECT IMPLEMENTATION

- Safety best practices
- Project management
- System commissioning
- Recycling program
- Measurement and verification services

CUSTOMER FOR LIFE

- Flexible financing options
- Ongoing maintenance and warranty support
- System fine-tuning for maximized savings
- Innovative technology evaluation for future upgrades

INTERIOR LIGHTING

Interior lighting fixtures are typically upgraded with new lamps, retrofit kits or new fixtures, depending upon the age of the existing system, code requirements and expected ROI.

LINEAR FLUORESCENT UPGRADES



- NEW LED FIXTURES**
- Potential designs with fewer fixtures



- LED RETROFIT KITS**
- Utilize existing housing and lens
 - Utilize existing housing with updated lens/look



- LED TUBES**
- Fluorescent ballast operated tubes
 - Direct-wire to line voltage tubes
 - Remote driver operated tubes

CFL/INC/HID UPGRADES



- NEW LED FIXTURES**
- Replace existing, typically only if required



- LED RETROFIT KITS**
- Use existing housing



- LED RE-LAMPS**
- Lamp-only replacement, if kits will not meet ROI

HIGH BAY FIXTURES



- NEW LED FIXTURES**
- Replace existing HID or FL fixtures

EXTERIOR LIGHTING

Exterior lighting fixtures are typically upgraded with new LED fixtures if the existing fixtures are HIDs (Metal Halide or High Pressure Sodium).

BUILDING MOUNTED FIXTURES



- WALL PACKS**
- New fixtures to replace existing HID, CFL and INC fixtures



- FLOODS**
- New fixtures to replace existing HID, CFL and INC fixtures



- CANOPY**
- New fixtures to replace existing HID, CFL and INC fixtures

POLE MOUNTED FIXTURES



- AREA AND STREET LIGHTS**
- New fixtures to replace existing HID fixtures



- POST TOP DECORATIVE**
- New fixtures to replace existing HID fixtures (new look)
 - Retrofit kits utilizing existing housings to maintain existing look or lower ROI



- HIGH MAST FIXTURES**
- New LED high output fixtures



- PARKING GARAGES**
- New LED fixtures to replace existing HID and FL fixtures
 - Motion controls
 - Ambient light controls
 - High-end trim

LIGHTING CONTROLS

Lighting controls can be designed as room-based controls, stand-alone networked controls or integrated networked controls into a Building Automated System, such as Metasys®.

ROOM-BASED CONTROLS



- OCCUPANCY SENSORS**
- Ceiling or wall mount
 - Wired or wireless



- PHOTOCELL SENSORS**
- Integrated into LED fixtures

STAND-ALONE NETWORKED CONTROLS



- ROOM-BASED CONTROLS NETWORKED INTO A STAND-ALONE LIGHTING CONTROL SYSTEM**
- Gateways communicate to central processor
 - Software for scheduling, high-end trim, monitoring, etc.

INTEGRATED NETWORKED CONTROLS WITH BAS (METASYS)



- NETWORKED LIGHTING CONTROL SYSTEM INTEGRATED INTO BAS (METASYS AND OTHERS) THROUGH BACnet**

SMART CITY CONTROLS



- LIGHTING AND COMMUNICATIONS TECHNOLOGY TO IMPROVE LIVABILITY, WORKABILITY AND SUSTAINABILITY**
- Security and safety
 - Maintenance and energy reporting
 - Monitoring
 - Traffic control

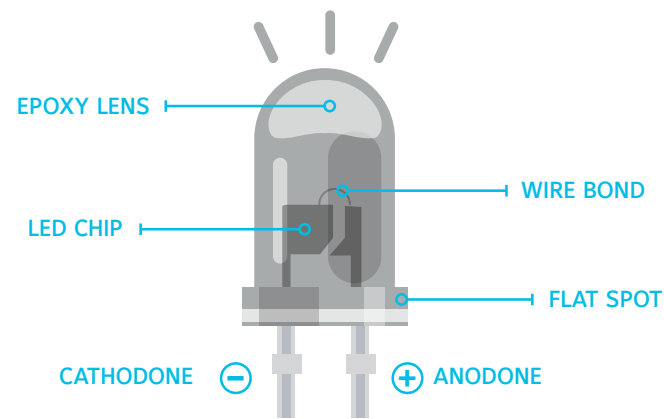
LIGHTING & LED TERMINOLOGY

SSL - SOLID STATE LIGHTING

SSL refers to a type of lighting that uses semiconductor light-emitting diodes (LEDs), organic light-emitting diodes (OLED) or polymer light-emitting diodes (PLED) as sources of illumination.

LED - LIGHT EMITTING DIODE

A light-emitting diode (LED) is a semiconductor device that emits visible light when an electric current passes through it.



ILLUMINATION

Illumination is the distribution of light on a horizontal surface. The purpose of all lighting is to produce illumination.

LUMEN

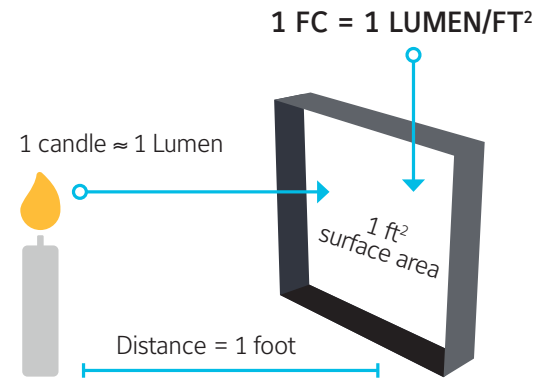
Lumen is a measurement of light emitted by a lamp. As reference, a 100-watt incandescent lamp emits about 1600 lumens.

LUMEN MAINTENANCE (L70)

L70 is the amount of time it takes for a fixture's lumen output to decrease by 30% from its initial lumen output. The rated life of a LED is typically based on L70, not when the LED is expected to fail.

FOOTCANDLE

A footcandle is the measurement of the intensity of illumination. A footcandle is the illumination produced by one lumen distributed over a 1-square-foot area. (Measuring the amount of light landing on a surface, i.e. the amount of light measured hitting a desk.)



CCT - COLOR CORRECTED TEMPERATURE

CCT is a measure of the color of a light source relative to a black body at a particular temperature expressed in degrees Kelvin (K). Incandescent lights have a low color temperature (approx. 2800K) and have a red-yellowish tone. Warm white LED Lamps have a color temperature between 2700-3500K, where 2700K is closest to incandescent. Typically 4000K is widely used for a neutral application. Lamps rated between 5000K and 6000K are viewed as white (daylight), while lamps above 6000K tend to have a blue cast. Manufacturers associate warmer color temperatures with calm, soothing environments where daylight promotes alertness and an 'awake' sensation.



SMART CITY

A smart city uses information and communication technology to improve its core systems and programs. Data is collected via sensors and other devices and communicated using wired and wireless networks. The data is analyzed to understand what's happening now and what's likely to happen in the future. This information can be used for improvements in lighting, safety, energy use, traffic control, parking management, pollution control and other areas.

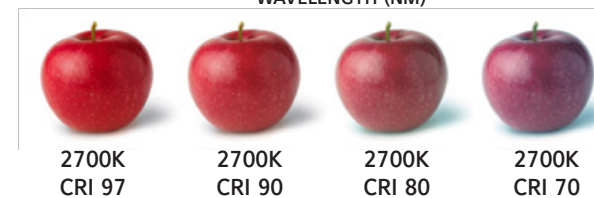
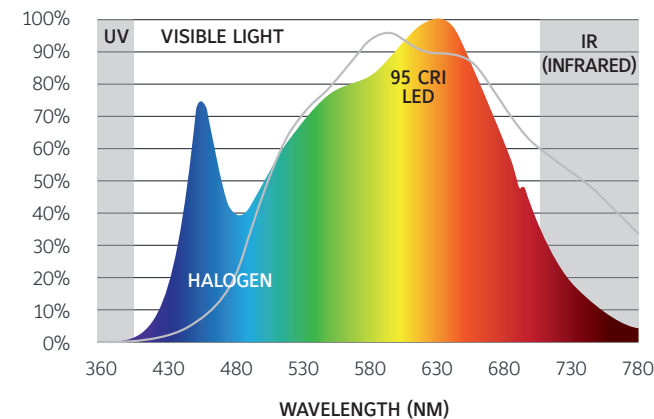
LUX

LUX is a measurement of the intensity of illumination. A Lux is the illumination produced by one lumen distributed over a 1-square-meter area.

$$1 \text{ LUX} = \text{FC} \times 10.76$$

CRI - COLOR RENDERING INDEX

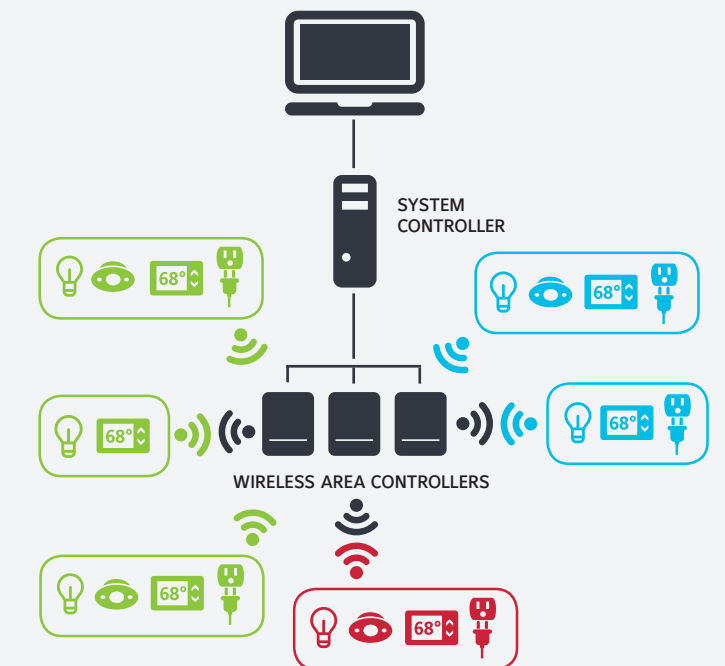
CRI is a measurement of how accurately the color of objects appears to us under different lighting conditions. Natural sunlight has a value of 100, in which all colors appear as they should. Color specific tasks may require a high CRI "true to daylight" value to achieve true color of product. Retail applications, museums, etc. typically may require a higher CRI value.



LIGHTING CONTROLS

THREE BASIC TYPES OF LIGHTING CONTROLS

- **Room-Based Lighting Controls** – Stand-alone devices (Motion Sensors, Photocells, Switches, etc.) that control the light fixtures in a room with no communication outside the space.
- **Networked Lighting Controls** – Room-Based Lighting Controls that are networked together through devices such as room controllers and gateways that communicate to a centralized software system.



- **Integrated Lighting Controls** – Networked Lighting Controls that are integrated into a Building Automated System (BAS) that will communicate with other building systems.