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· August 15-18, 2010 · Dallas, Texas ·
· Dallas Convention Center ·


# Introduction to Light Emitting Plasma

# Overview of Plasma Lighting

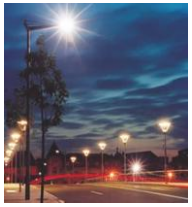
LUXIM®

# World of Lighting, Complimenting LED

HIGH LUMENS

HID

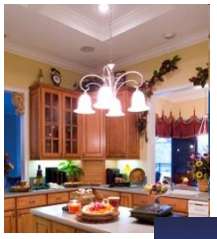
Plasma



OLD

NEW

Energy Savings
Low Maintenance
Lighting Controls



Incandescent

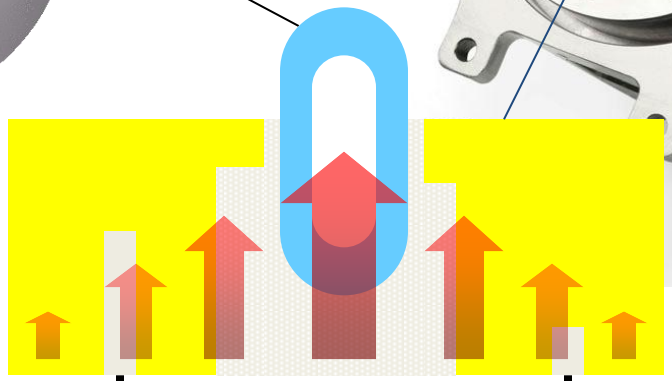
LED

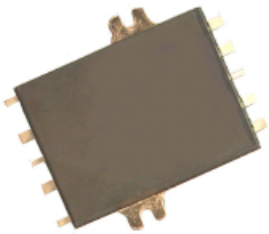
LOW LUMENS

# LEP Components

Quartz Bulb
+
Rare Earth,
Halide Fill

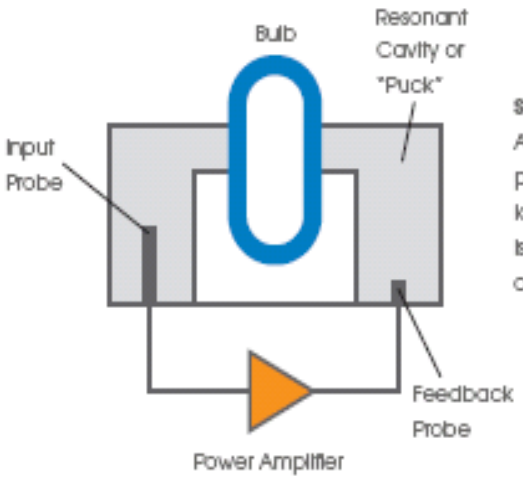
Resonator
(High Purity
Ceramic)





RF Power
Amplifier
(LDMOS)

# How LEP Works




**Step 1:**
An RF circuit is established by connecting an RF power amplifier to a ceramic resonant cavity known as the "puck". In the center of the puck is sealed quartz bulb that contains materials consistent with metal-halide lamps.

**Step 2:**
The puck, driven by the power amplifier, creates a standing wave confined within its walls. The electric field is strongest at the center of the bulb which ionizes the gasses inside the bulb (purple glow).

**Step 3:**
The ionized gas in turn heats up and evaporates the metal-halide materials which form a bright plasma column within the bulb (blue to bright white light). This plasma column is centered within the quartz envelope and radiates light very efficiently. In the back side of the bulb, a highly reflective powder is used to reflect nearly all of this light in the forward direction.

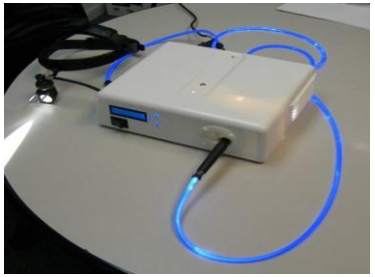
# Light Emitting Plasma Components

Driver


Emitter

# Market leading solutions

## Instrumentation




## Entertainment

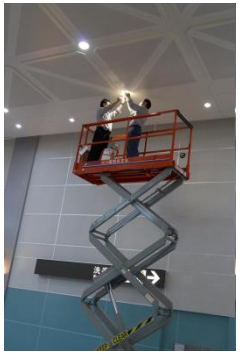

## Area Lighting

# Ideal Applications

Compact/Beam

High Output

Daylighting/Low Occupancy



Low Maintenance

LEP

High Color Quality

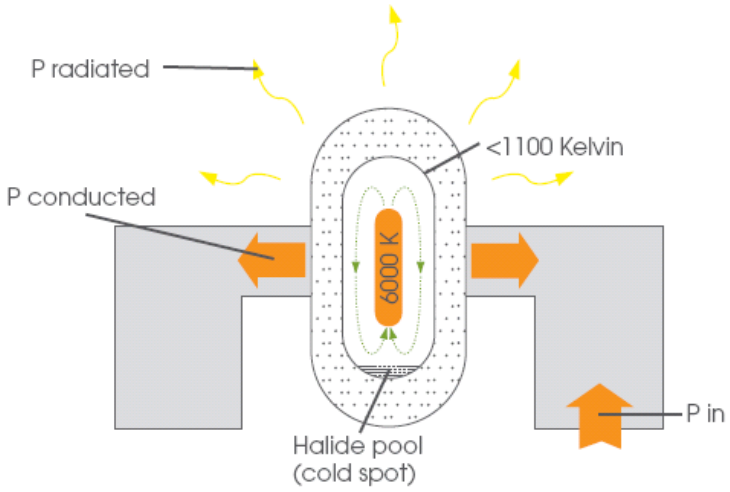
Light-pipe Distribution

Full Cutoff – Dark Sky

# Technology Comparison

LUXIM

# Technology Advantage: No Electrodes

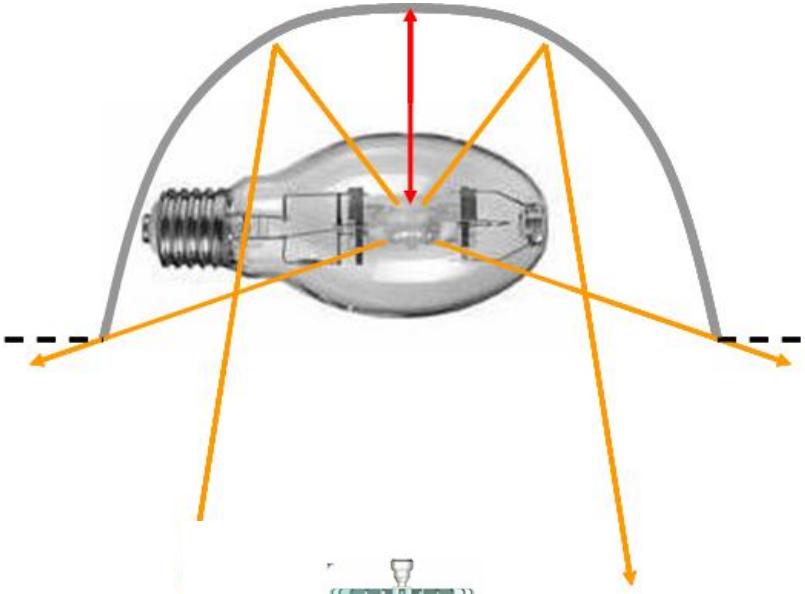



At steady state, the gases (Ar, Hg, metal halides) are in local thermodynamic equilibrium.

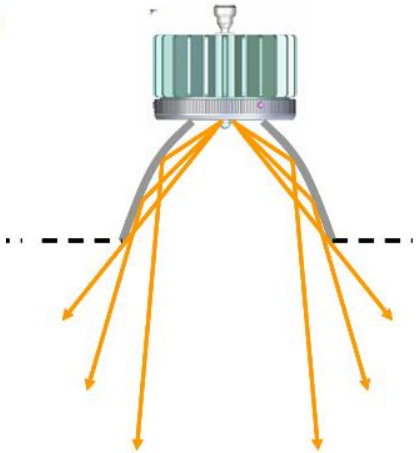
1. **Stable Power Delivery**
   - **No arc flicker electrode tips**
   - **No tungsten sputter (wall darkening)**
   - **Dimming extends life**
2. **No Mechanical Failures**
   - **No glass to metal seal**
   - **No reaction of fill to tungsten electrodes**
3. **Rapid Start and Re-Strike**


# Technology Advantage: Directional Emission

HID



LEP

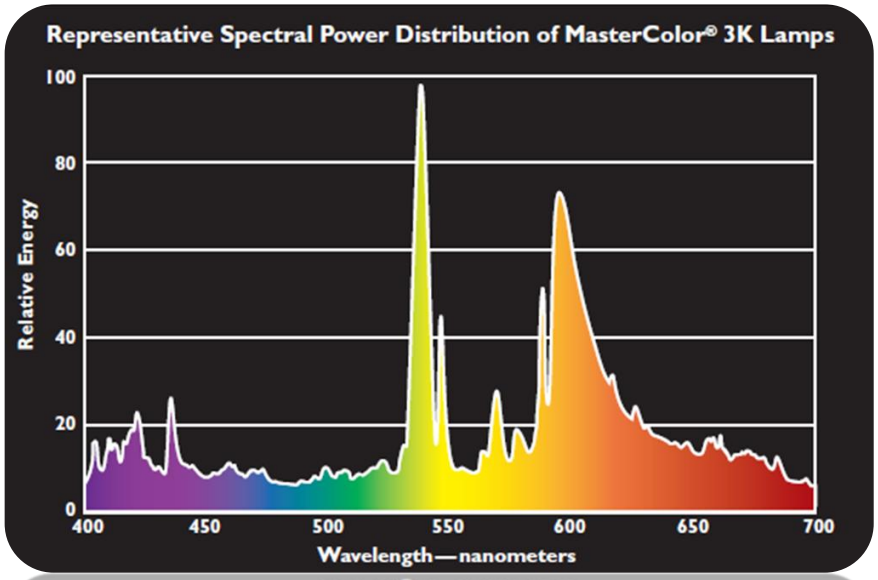


**Superior light control:**

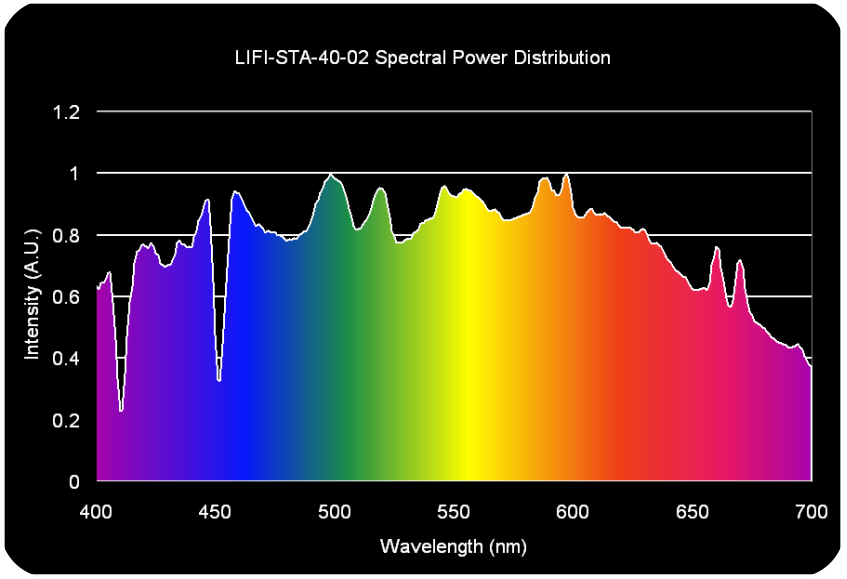
1. **Higher fixture efficiency**
2. **Better uniformity and distribution**
3. **Compact optics**

# Technology Advantage: Spectrum

## CMH




## LiFi®

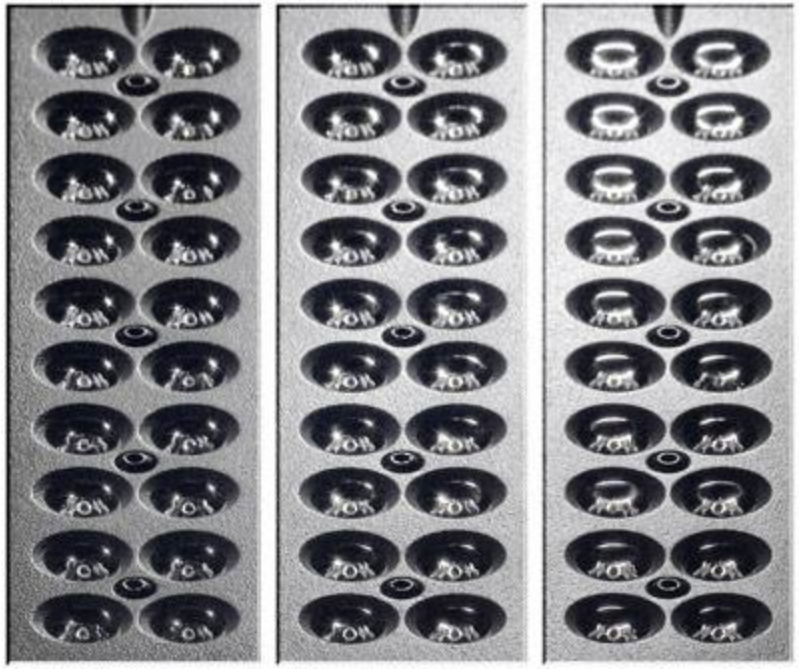


# Comparative Analysis

LIFI

=

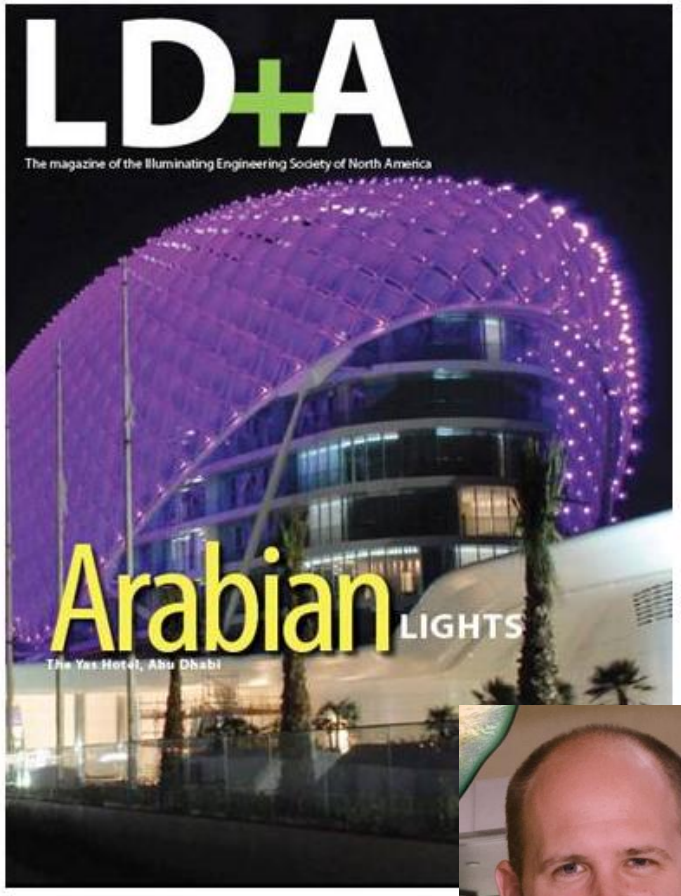
=



220 High
Brightness LEDs

LED for low illuminance
LEP for high illuminance

# LED and LEP are the new Energy Efficient, Long Life Technologies




"With LEDs and Light Emitting Plasma (LEP) expanding so quickly there is nothing else you will need to design with in the next couple of years.

… and it's game over. I really don't see anything that LED/LEP can't do in the near term. It's only a matter of time before all other forms of lighting are in the Smithsonian."

John Fox, Principle
Fox & Associates Lighting Designers
Lighting Design and Applications, Feb/2010

# Example: Roadway/Area Fixture

LEP ($800)

19,000 Lumens

LED ($1900)

B2-U1-G1

275 Watts

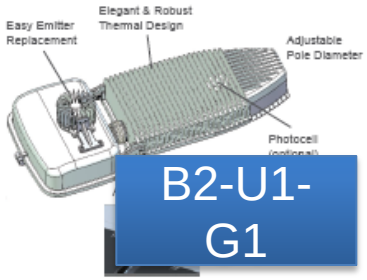
287 Watts

240 LEDs

21,000 Lumens (B3-U1-G3)

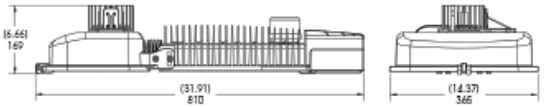
16,000 Lumens (B2-U1-G2)

**LEP™ Street Light, Type II** Developed by Stray Light Optical Technologies




Performance specification in street lighting application:

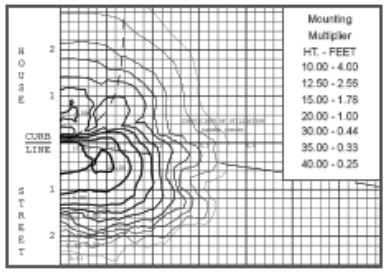
| | |
|---|---|
| Source Lumens | 23,000 |
| Fixture Lumens | 19,300 |
| Watts | 266 |
| Voltage | 120, 220, 277 |
| Fixture Efficacy | 73 L/W |
| Lifespan | 50,000 hours |
| CCT | 6000 K |
| CRI | 80 |
| Distribution Type | II, Short |
| Uniformity (Max/Avg) | 2:1 |
| Cut-Off | Full |
| Weight | 30 lbs. |
| IES BUG Rating | B2 U1 G1 |



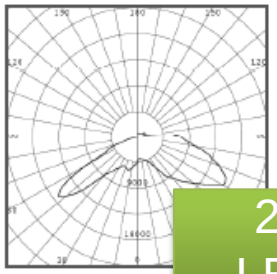

LEP™ streetlight is designed with LIFI-STA-41-01 plasma light source that has been certified per UL1029 and EN61347. The materials used in the light fixture is RoHS compliant. The photometric testing is done per IESNA LM-79-08 standards. The light fixture is designed to be compliant to outdoor standards and withstand most rigorous environmental conditions.

**Photometrics**

Iso–footcandle plot (1 footcandle = 10.8 lux)

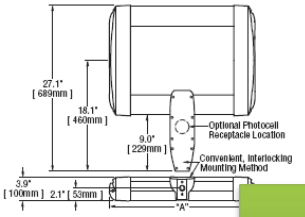



Candle power distribution curves.



Stray Light Optical Technologies 821 S. Lake Road South, Scottsburg, IN 47170 (812) 752-0104 info@

Notes:




| # of LEDs | Dim. "A" |
|---|---|
| 20 | 11.75" |
| 40 | 11.75" |
| 60 | 13.75" |
| 80 | 15.75" |
| 100 | 17.75" |
| 120 | 19.75" |
| 140 | 21.75" |
| 160 | 23.75" |
| 180 | 25.75" |
| 200 | 27.75" |

**LED PERFORMANCE SPECS**

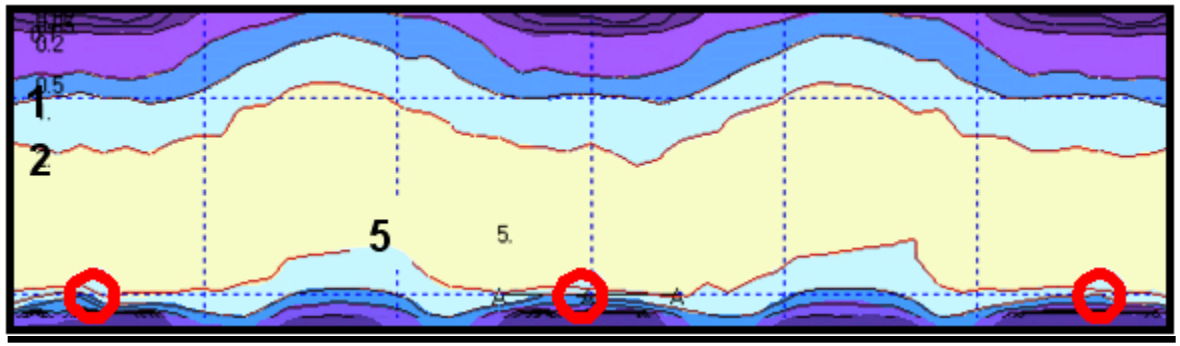
| LEDs | Initial Delivered Lumens – Type II Short @ 6000K | B | U | G | Rating[3] | Initial Delivered Lumens – Type II Short w/ Backlight Control @ 6000K | B | U | G | Rating[3] | Initial Delivered Lumens – Type II Short @ 4300K | B | U | G | Rating[3] | Initial Delivered Lumens – Type II Short w/ Backlight Control @ 4300K | B | U | G | Rating[3] | System Watts 120–277V | Total Current @ 120V | Total Current @ 230V | Total Curre @ 27 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **350mA (Standard) Fixture Operating at 25° C (77° F)** | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 20 | 1,752 (02) | 1 | 1 | 1 | | 1,360 (02) | 0 | 1 | 0 | | 1,537 (02) | 1 | 1 | 1 | | 1,193 (02) | 0 | 1 | 0 | | 29 | 0.25 | 0.14 | 0.13 | 31 | 0.09 | 0.08 | 104,935 |
| 40 | 3,504 (04) | 1 | 1 | 1 | | 2,720 (04) | 1 | 1 | 1 | | 3,073 (04) | 1 | 1 | 1 | | 2,386 (04) | 1 | 1 | 1 | | 50 | 0.43 | 0.24 | 0.21 | 54 | 0.16 | 0.12 | 104,935 |
| 60 | 5,255 (06) | 2 | 1 | 2 | | 4,081 (06) | 1 | 1 | 1 | | 4,610 (06) | 1 | 1 | 1 | | 3,579 (06) | 1 | 1 | 1 | | 78 | 0.65 | 0.37 | 0.35 | 81 | 0.23 | 0.18 | 104,935 |
| 80 | 7,007 (08) | 2 | 1 | 2 | | 5,441 (08) | 1 | 1 | 1 | | 6,146 (08) | 1 | 1 | 1 | | 4,772 (08) | 1 | 1 | 1 | | 100 | 0.84 | 0.47 | 0.41 | 102 | 0.29 | 0.22 | 104,935 |
| 100 | 8,759 (10) | 2 | 1 | 2 | | 6,801 (10) | 1 | 1 | 1 | | 7,683 (10) | 2 | 1 | 2 | | 5,965 (10) | 1 | 1 | 1 | | 115 | 0.98 | 0.52 | 0.44 | 121 | 0.35 | 0.26 | 104,935 |
| 120 | 10,511 (12) | 3 | 1 | 3 | | 8,161 (12) | 1 | 1 | 1 | | 9,219 (12) | 2 | 1 | 2 | | 7,158 (12) | 1 | 1 | 1 | | 138 | 1.18 | 0.62 | 0.52 | 145 | 0.42 | 0.31 | 104,935 |
| 140 | 12,263 (14) | 3 | 1 | 3 | | 9,522 (14) | 2 | 1 | 2 | | 10,756 (14) | 3 | 1 | 3 | | 8,352 (14) | 1 | 1 | 1 | | 164 | 1.64 | 0.74 | 0.63 | 172 | 0.50 | 0.37 | 104,935 |
| 160 | 14,014 (16) | 3 | 1 | 3 | | 10,882 (16) | 2 | 1 | 2 | | 12,292 (16) | 3 | 1 | 3 | | 9,545 (16) | 2 | 1 | 2 | | 187 | 1.57 | 0.84 | 0.71 | 195 | 0.59 | 0.41 | 104,935 |
| 180 | 15,766 (18) | 3 | 1 | 3 | | 12,242 (18) | 2 | 1 | 2 | | 13,829 (18) | 3 | 1 | 3 | | 10,738 (18) | 2 | 1 | 2 | | 208 | 2.10 | 0.94 | 0.80 | 218 | 0.64 | 0.46 | 104,935 |
| 200 | 17,518 (20) | 3 | 1 | 3 | | 13,602 (20) | 2 | 1 | 2 | | 15,365 (20) | 3 | 1 | 3 | | 11,931 (20) | 2 | 1 | 2 | | 230 | 1.95 | 1.03 | 0.88 | 241 | 0.71 | 0.51 | 104,935 |
| 220 | 19,270 (22) | 3 | 1 | 3 | | 14,962 (22) | 2 | 1 | 2 | | 16,902 (22) | 3 | 1 | 3 | | 13,124 (22) | 2 | 1 | 2 | | 254 | 2.13 | 1.13 | 0.96 | 264 | 0.77 | 0.56 | 104,935 |
| 240 | 21,022 (24) | 3 | 1 | 3 | | 16,323 (24) | 2 | 1 | 2 | | 18,438 (24) | 3 | 1 | 3 | | 14,317 (24) | 2 | 1 | 2 | | 277 | 2.34 | 1.23 | 1.03 | 287 | 0.86 | 0.60 | 104,935 |
| **525mA Fixture Operating at 25° C (77° F)** | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 20 | 2,271 (02) | 1 | 1 | 1 | | 1,768 (02) | 0 | 1 | 0 | | 1,997 (02) | 1 | 1 | 1 | | 1,551 (02) | 0 | 1 | 0 | | 38 | 0.32 | 0.18 | 0.16 | 44 | 0.12 | 0.11 | 60,685 |
| 40 | 4,555 (04) | 1 | 1 | 1 | | 3,537 (04) | 1 | 1 | 1 | | 3,995 (04) | 1 | 1 | 1 | | 3,102 (04) | 1 | 1 | 1 | | 70 | 0.59 | 0.32 | 0.27 | 77 | 0.23 | 0.18 | 60,685 |
| 60 | 6,832 (06) | 2 | 1 | 2 | | 5,305 (06) | 1 | 1 | 1 | | 5,992 (06) | 2 | 1 | 2 | | 4,653 (06) | 1 | 1 | 1 | | 106 | 0.89 | 0.49 | 0.44 | 115 | 0.33 | 0.25 | 60,685 |
| 80 | 9,109 (08) | 2 | 1 | 2 | | 7,073 (08) | 1 | 1 | 1 | | 7,990 (08) | 2 | 1 | 2 | | 6,204 (08) | 1 | 1 | 1 | | 139 | 1.16 | 0.63 | 0.55 | 148 | 0.43 | 0.32 | 60,685 |
| 100 | 11,387 (10) | 3 | 1 | 3 | | 8,841 (10) | 2 | 1 | 2 | | 9,987 (10) | 3 | 1 | 3 | | 7,755 (10) | 1 | 1 | 1 | | 180 | 1.54 | 0.82 | 0.72 | 192 | 0.56 | 0.41 | 60,685 |
| 120 | 13,664 (12) | 3 | 1 | 3 | | 10,610 (12) | 2 | 1 | 2 | | 11,985 (12) | 3 | 1 | 3 | | 9,306 (12) | 2 | 1 | 2 | | 217 | 1.82 | 0.99 | 0.84 | 226 | 0.66 | 0.49 | 60,685 |

1. Utilizes magnetic step-down transformer
2. For recommended lumen depreciation data see TD-13
3. For more information on the IES BUG (Backlight-Uplight-Glare) Rating visit www.iesna.org/PDF/Erratas/TM-15-07BugRatingsAddendum.pdf

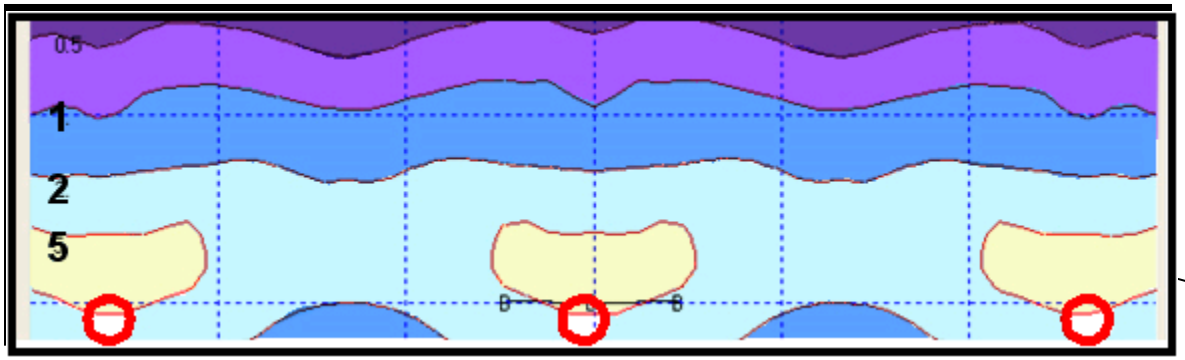
# Iso-Illuminance Plot (Ft-Cd)

**12 m height, 40 m spacing, 16 m width**

**Pole Location**




**Light Emitting Plasma**
Type2 Full Cutoff Short/Med
STA-41-01




**High-Pressure Sodium**
Type2 Full Cutoff Med
400W HPS

*hotspot*

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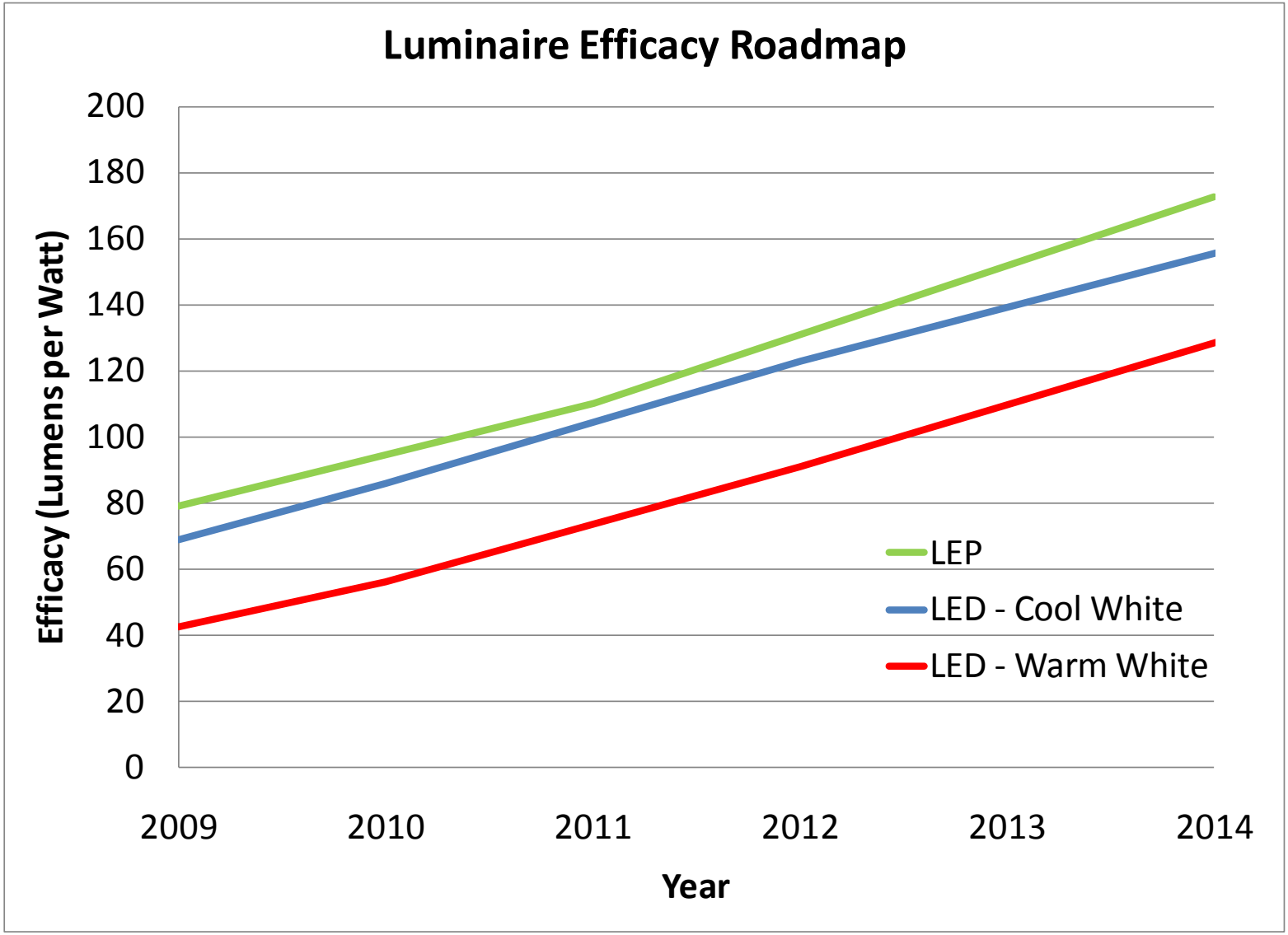
**GovEnergy 2010**




*Source: LED data from DOE MYPP 2010*

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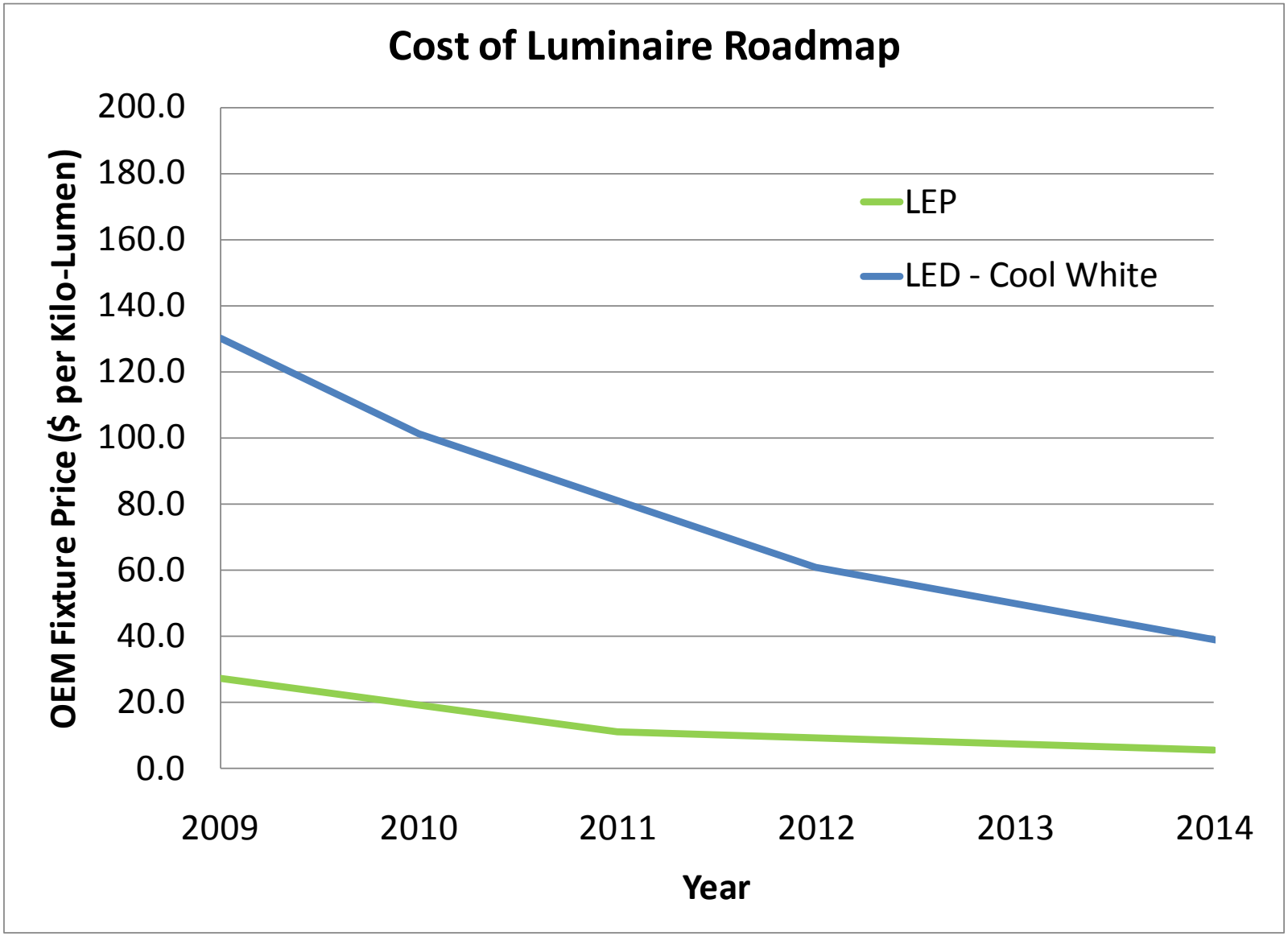
**GovEnergy 2010**




*Source: LED data from DOE MYPP 2010 and DOE SSL Manufacturing Workshop 2009*

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**GovEnergy 2010**

# Cost Savings

| | HPS 400W | LIFI-STA-41 Full Power | LIFI-STA-41-01 Hi/Lo |
|---|---|---|---|
| Avg Power - Watts | 465 | 273 | 191 |
| Daily Usage - Hours | 12 | 12 | 12 |
| Total KW-Hr | 2037 | 1196 | 837 |
| Tons of $CO_2$/Year | 1.53 | 0.90 | 0.63 |
| $/kW-hr | 0.13 | 0.13 | 0.13 |
| Yearly Electricity Cost - $ | 265 | 155 | 109 |
| Replacement Cycle - Hrs | 18000 | 50000 | 50000 |
| Lamp Replacement Cost - $ | 150 | 250 | 250 |
| Yearly Replacement Cost - $ | 37 | 22 | 22 |
| Total Cost - $ | 301 | 177 | 131 |
| **Annual $ Savings** | **0** | **124** | **171** |
| **Annual CO2 Savings - Tons** | **0.00** | **0.63** | **0.90** |
| Fixture Cost - $ | 400 | 800 | 800 |
| Installation Cost - $ | 207 | 207 | 207 |
| Utility Rebate - $ | 0 | 100 | 100 |
| **Payback - years** | **-** | **2.4** | **1.8** |

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www.govenergy.gov

**$ Savings Per Fixture**

**GovEnergy 2010**

# Applications

# Application Images

# LEP Portable Work Light


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GovEnergy 2010


✓Same Energy
✓Triple Light Levels
✓Improved Color
✓Improved Visibility
LEP Streetlights
Existing HID Streetlights

# Street Lighting



| | Before | After |
|---|---|---|
| Wattage | 470 | 273 |
| Avg Lux | 31 | 36 |
| Min Lux | 11 | 10 |
| Uniformity (Min/Avg) | .35 | .33 |


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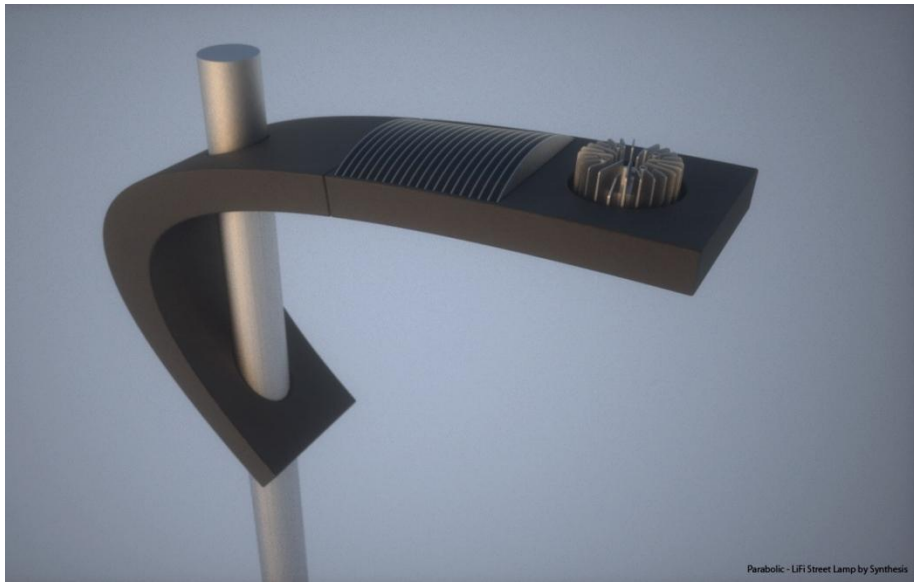
www.govenergy.gov

**GovEnergy 2010**


HPS (470 system watts)


LEP (273 system watts)
✓ Improved Color
✓ Improved Uniformity
✓ Improved Appearance

# LEP Roadway/Pedestrian



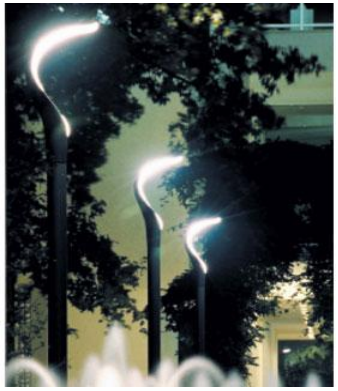

Make us think of waves


Hawaii… or the French Riviera on a beach by the seaside

*park your car and go swim!*

# Smoothing out the wave

# Suitable Applications (250W to 400W)



Indirect

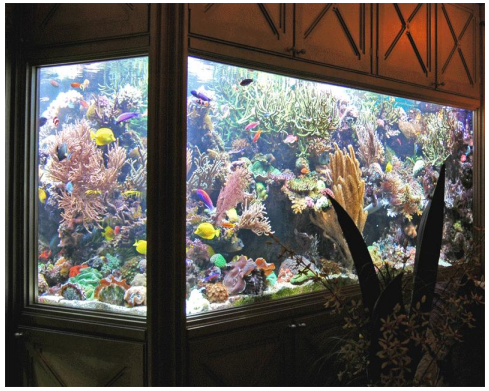
Architecture

Parking

Tunnel


Signage

Industrial



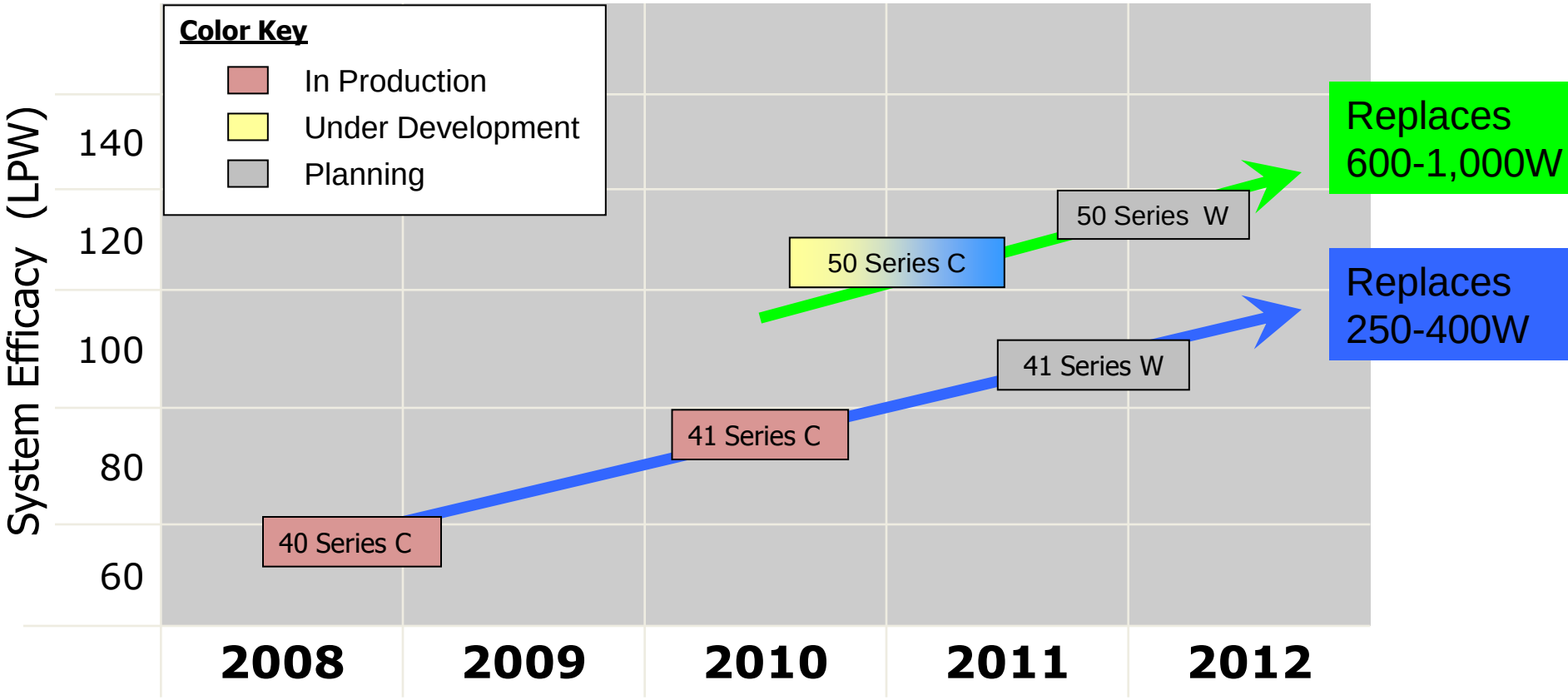
Aquarium

# Future Developments

## Subtitle Goes Here

LUXIM®

# LUXIM LEP Area Lighting Roadmap




C - Cool color temperature
W – Warm color temperature

# Suitable Applications (600W to 1000W)

Sports

Grow Lighting

High Mast


Auto Mall

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