MEETING THE EVER-GROWING DEMAND FOR "GREEN" LEDS

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The Promise of SSL

- Energy efficient
- Ultra-long life
- Small size
- Versatility
- Broad range of temperature
- Dimmable
- Any color desired

Most Current Installations

- Color changing
- Patterns of light
- Often designed to interact with diffusing material

Well-known problems of SSL

- Not especially efficient outside of the lab
- White light is hard to create
- White color quality not too good
- Temperature issues affect life and output
- Uneven depreciation of different color LED’s
- Expensive when good
- Not so good when inexpensive
- Very small bang very big buck

Limitations of Early SSL Products

- Color changing is comparatively easy
- White light, not so easy
- Limited light output
- Extremely high $$$ per lumen
- No more efficient than incandescent lighting

Recent Progress

- Practical understanding of temperature issues
- Ability to achieve >50 lumens per watt with warm toned white light
- Ability to achieve CRI>80 using blended LED
- Preliminary standardization of electrical characteristics

Breakthrough Product 2007

- The Cree Downlight
- 600+ lumens
- 12 watts
- Dimmable
- 2700K
- >90 CRI
- Use in almost any standard 6” downlight including IC-AT

LED Lighting 2008

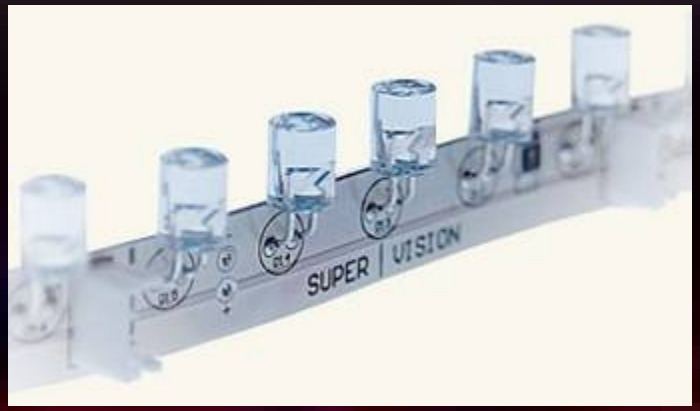
- Evolving practical products
  - White light
  - Color
  - Color changing
- Products with useful amount of light
- Light distribution methods offering many new options

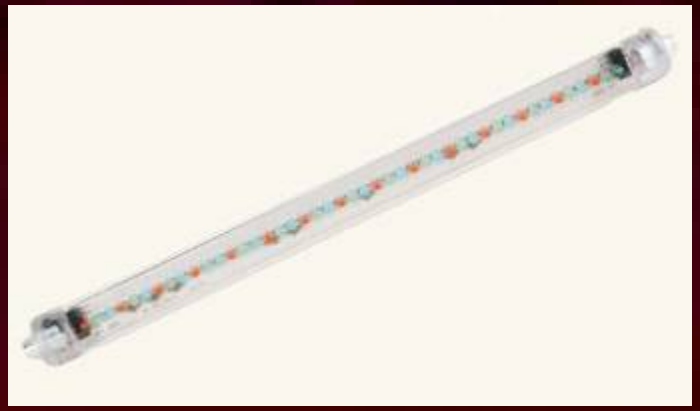
Principal Directions

- LED Components
- LED Bulbs
- LED Projectors
- LED Engines
- LED Fixtures
- LED Special Products
- LED Systems

LED Components

- Simple basic building blocks
- Made by LED makers/electronics companies
- Used by fixture companies





LED Bulbs

- Fit into incandescent sockets
- Pretend to be incandescent lamps
- Primary Issue: incandescent lamps don’t need heat sinks
- A retrofit approach with limited possibilities

LED Projectors

- PAR and MR lamp styles
- Watt limited by heat sink issue
- Applicability concerns, such as overheating problems in AT-IC downlights

LED Engines

- Lumen package based
- Integral heat sink
- Form factor suitable for conventional or new luminaires
- Hemispherical radiator
- Blended white light

The LED Engine

- Lumen package concept
- Works for downlights and projectors
- Sizes
  - 600 lumen (12 w) = 75 watt R lamp
  - 1200 lumen (24 w) = 26 watt CFL fixture
  - 2000 lumen (40 w) = 42 watt CFL fixture

LED Fixtures

- The lamp is the fixture
- Replace fixture not lamp

LED Fixtures

- Best when the fixture can be a good heat sink, too

LED Special Products

- Lighting for pools and water features (Water keeps LED's cool)

LED Special Products

- Lighting for pools and water features

LED Special Products

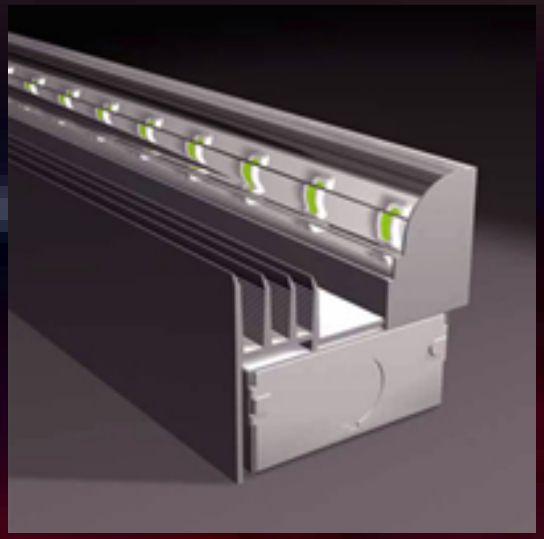
- Lighting for refrigerators (another “cool” spot)

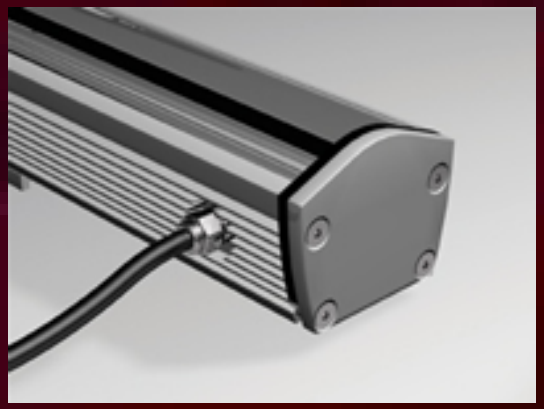
LED Special Products

- Special fixtures for optimum applications

LED Systems

- Flexible systems with broad applicability





Assessment

- Are LED’s practical?
- Are LED’s cost effective?
- Are LED’s efficient?
- Are LED’s ready to play a major role?

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System efficiency for better products is now as high as compact fluorescent or some HID.

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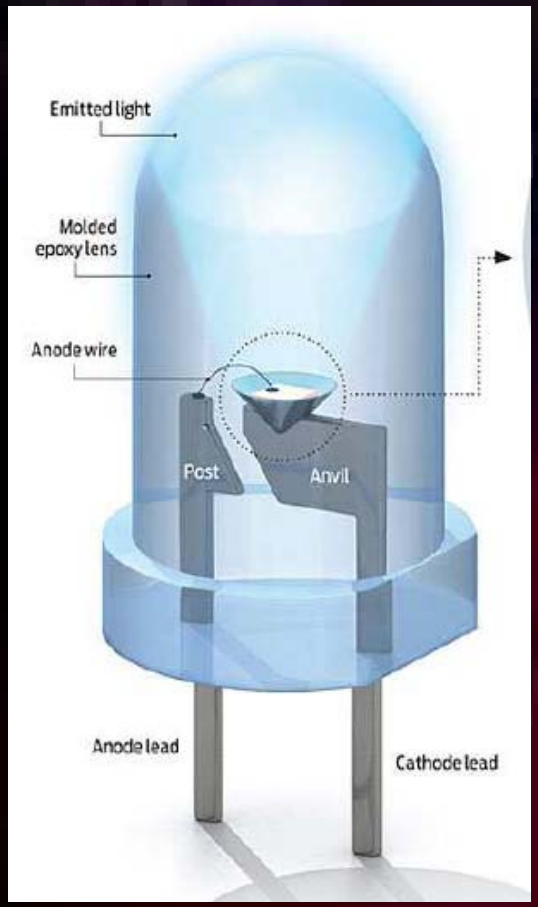
System efficiency for better products …

- Are LED's ready to play a major role?

Yes, in applications where cost is acceptable.

The State of LED Development



- White LED
  - Blue LED
  - Internal Phosphor
  - External Phosphor
- CRI>80
- 50 LPW/2900K
- 80 LPW/5000K+
- 3 watts or more per device possible

Source: IEEE "Spectrum"

LED Electrics

- LED low voltage diode ~ 2.5 volts
- LED current
  - 350 mA, 0.8 watt
  - 700 mA, 1.7 watt
  - 1000 mA, 2.5 watt
- Power supply converts building AC to low voltage DC
- Driver regulates flow to LED

Not as easy as it looks

EVALUATING LED OPPORTUNITIES

LED Strengths

- Small
- No IR or UV
- Sparkle
- Extremely long rated life
- Efficient (absolute photometry)

LED Weakness

- Costly
- Low per/lumens per source
- Problems with power density
- Efficacy not superior to HID and <<linear fluorescent

Leading edge or bleeding edge?

USING LED IN REAL LIFE RETAIL

Retail Lighting Layers

- General area lighting
- Decorative/special effects lighting
- Display lighting
  - Feature displays
  - Merchandise displays
  - Store windows

LED Area Lighting

Downlights	👍	High end stores
	👎👎	General merchandise
Cove lights	\👍	High end stores
	👎👎	General merchandise
Linear lighting	👎👎	Low efficacy
Troffers	👎👎	Low efficacy

LED Special Effects Lighting

- Shaping lights
- Back lights
- Letters and Neon Replacement

IES Greensboro **MEETING THE EVER-GROWING DEMAND FOR “GREEN” LEDS**

Point Source Considerations

- Spot (8-12°)
- Narrow Flood (22-28°)
- Flood (30-40°)
- Wide Flood (>50°)
- Beam shaping ability (softening lens, linear lens, snoot)

LED Display Lighting (SP)

Source	Watts	Beamspread	CBCP
45R20 Halogen	45	Spot ?	450
37MR16/HIR	35-37+	Spot 8-10	12500
LED Light Engine	15	Spot 12	5100
MR16 LED	7+	Spot 12	1440
20MR16 Halogen	20+	Spot 10	3400
20MR16/HIR	20+	Spot 8	6000
Monopoint LED	20	Spot 8	15000
AR111 Halogen	50+	Spot 8	23000
25 watt CMH Integral	25	Spot 10	26000

LED Display Lighting (NFL)

Source	Watts	Beamspread	CBCP
40PAR30/HIR/NFL	40	25	2900
40PAR38/HIR/NFL	45	25	3000
35-37MR16/HIR/NFL	37+	24	4400
30 WMR16/HIR/NFL	30+	24	3000
20 watt Monopoint	20	28	3000
15 watt Light Engine	15	23	2100
AR111	50	24	4000
12 watt LED PAR38	12	20	4000
25 watt CMH Integral	25	25	5600

Linear Display Sources

- Undershelf
- Display Cabinet
- Valance
- Horizon

Code Related Issues

- Efficacy
- Lamp Base
- Track Mounting

Application Issues

- Power Supplies
- Controls
- Dimming
- Color

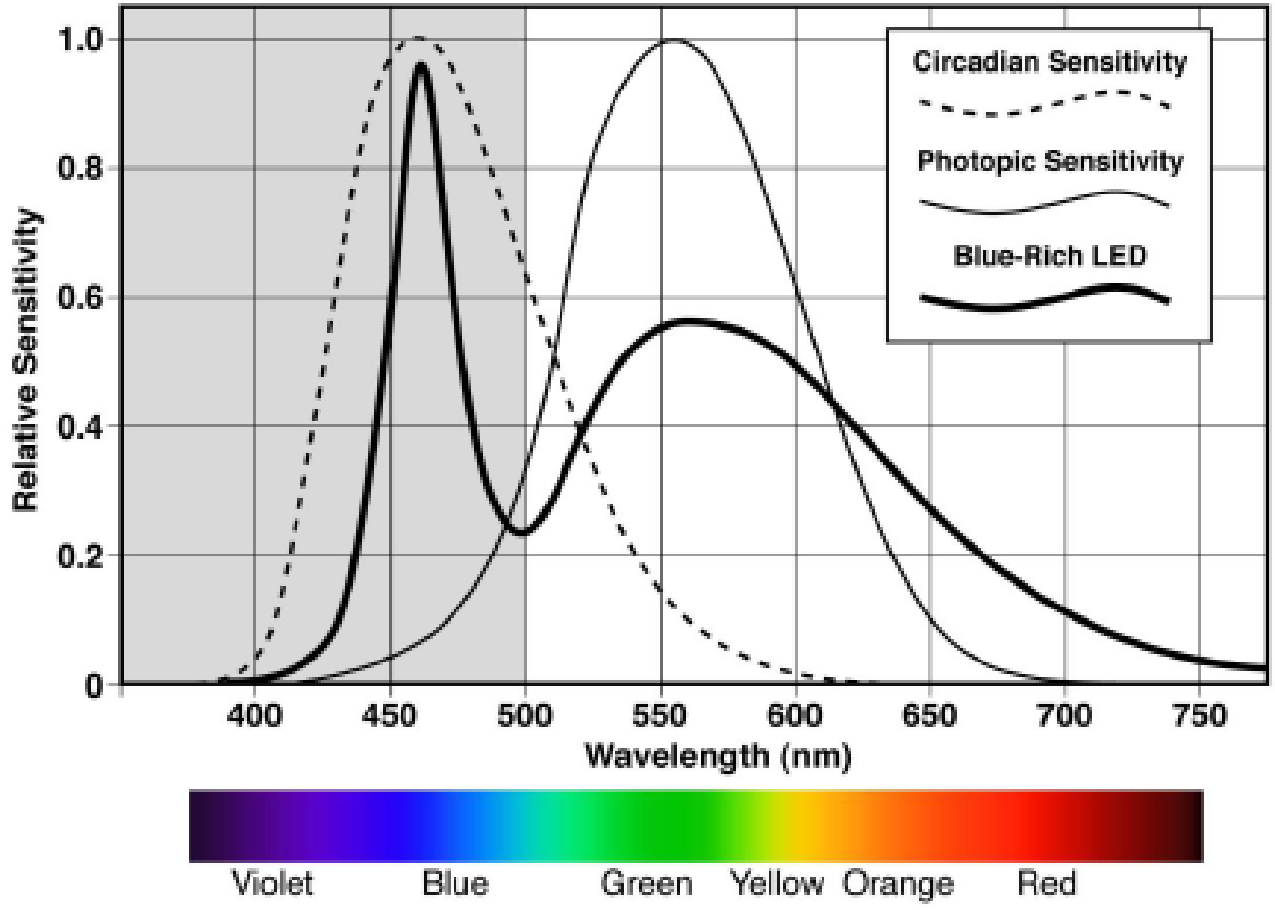
Street Lighting

KELLY O

THIS IS A TEST One of the "zombie blue" lights on 22nd Avenue East. More test lights will go up in South Park next month.

Parking Lot Lighting

Dark Skies and LED's



Special Issues

- Temperature
- Lamp life
- Warranty
- Cost effectiveness

www.benyalighting.com

QUESTIONS?

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