What's Next for Mid-Power LEDs for Lighting Applications

Philips Lumileds

April 4, 2014

Mid-Power LEDs

Driving LED adoption in general lighting

- Mid-power defined as <1 W, typically 0.3-0.5W
- Prevalent for display backlight – TVs, monitors, portable devices
- Single form factor, e.g. 5630
- Narrow range of cool white temperature





- Increasing penetration for general lighting
- Focus on criteria such as:
  - Long term lumen maintenance
  - Different form factors
  - Different CCTs

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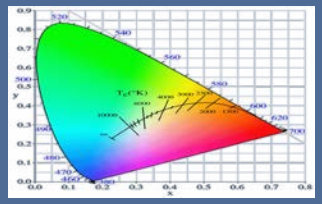
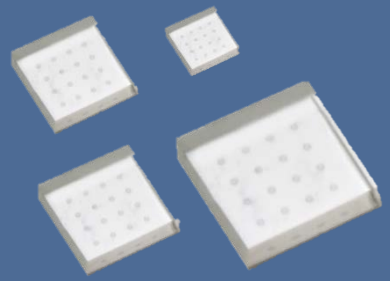
Application-Optimized LEDs

Optimization along key parameters

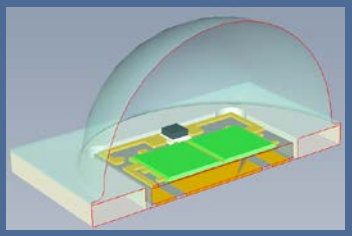
Quality of light – CCT/CRI, R9



Lumen package



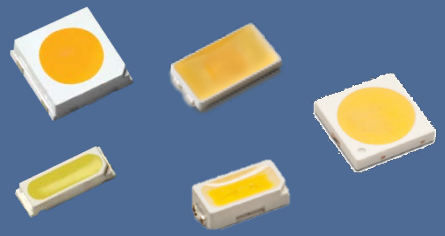
Reliability



Efficacy

200 lm/W

Form factor



Cost

LED and system lm/$

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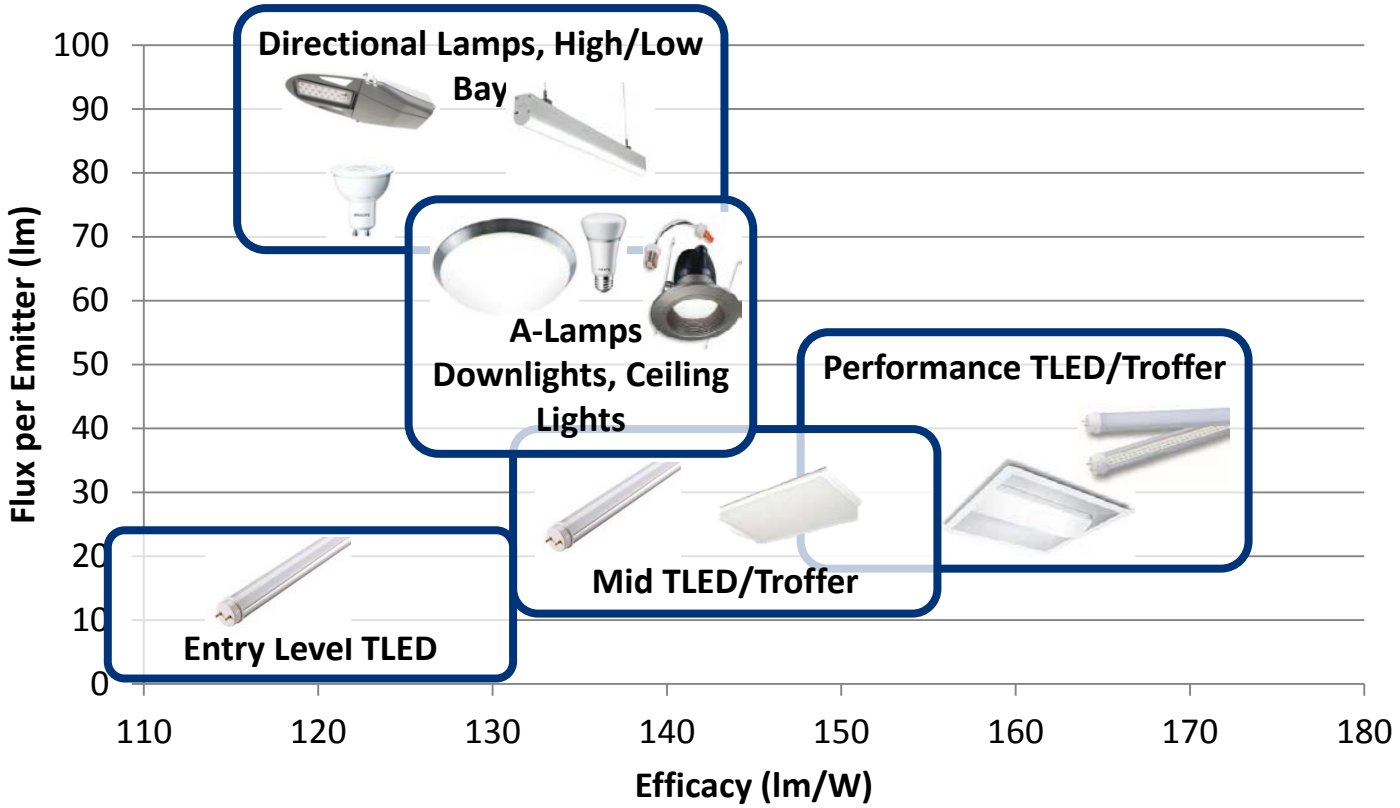
Applications Addressed by Mid and Low Lumen Package LEDs



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Non-Directional Applications: Mainstream

History

- Move towards energy efficient bulbs started with CFLs
- What was the reaction? CFL's have great efficacy, but…
  - Customer dis-satisfaction
  - Slow start time
  - Toxic mercury content
  - Grey green glow

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Non-Directional Applications: Mainstream

Reaction from New York Times

Green

Energy, the Environment and the Bottom Line

JANUARY 15, 2009, 11:07 AM

Light Bulbs: Which Do You Use?

By TOM ZELLER JR.

Consumers are divided over compact fluorescent light bulbs and their predecessor, the incandescent bulb. (Photo: Justin Maresch/Shutterstock)

The facts are plain. Compact fluorescent light bulbs — or C.F.L.s — use less energy and, over the long haul, save money.

My experience with the new bulbs has been dismal. The quality of the light is bad until they warm up. They cost 3 to 5 times as much as an incandescent, and if you have old-fashioned energy-saving habits like turning off the lights when you leave the room, they don't last any longer than the tungsten bulbs (sometimes less). And they're more difficult to dispose of properly because of the toxic content. Maybe L.E.D. lights will be better if the price can become reasonable. — *Pieter*

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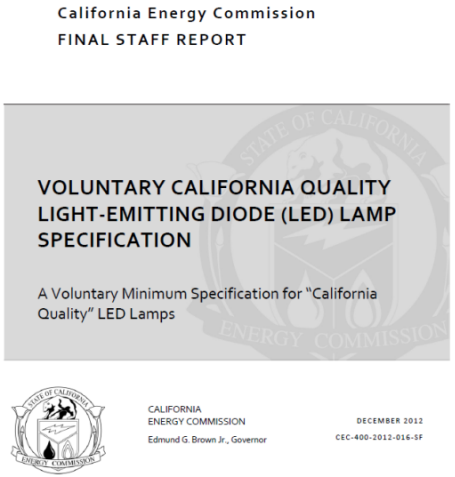
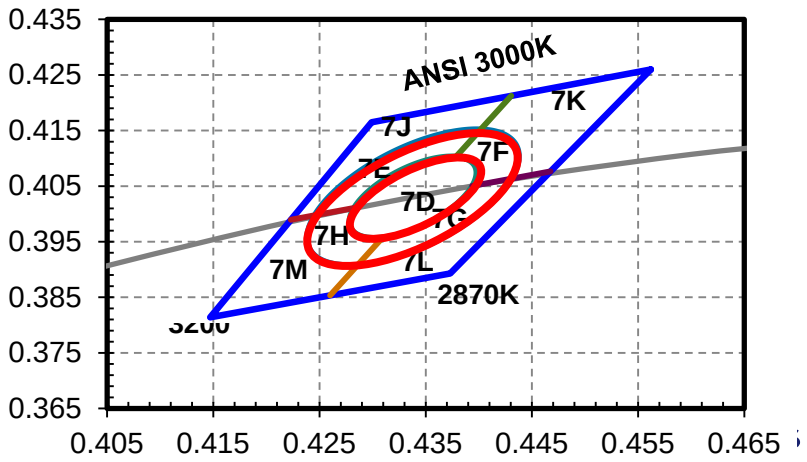
LEDs Offer Superior Quality of Light

LEDs solve quality of light issues with warmer CCTs and tight color binning

- Instant “on”
- ENERGY STAR® calls for 80 CRI and R9>0
  - California specifications: 90 CRI and R9>50
- Ultra warm colors: 2200K/2500K
- New LEDs, such as the LUXEON 3030 2D and LUXEON 3020
  - Hot color targeting
  - 1/9th micro color binning



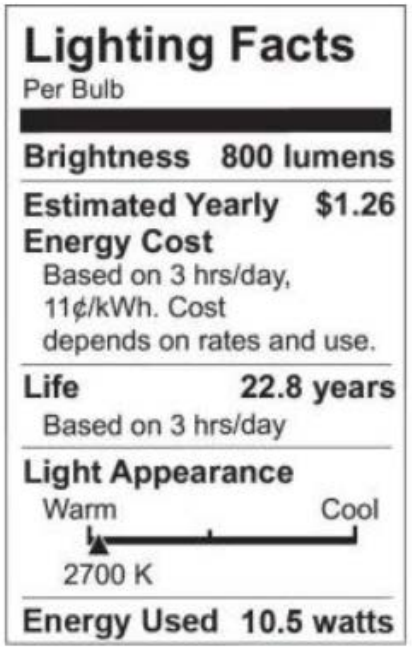


Non-Directional Applications: Mainstream

Summary

- LED bulb efficacy well beyond ENERGY STAR® minimums
- A19 lamps are hitting 80 lm/W
- LEDs offer kitting to achieve tight color targeting
- Ability to kit greatly expands utilization

Bulb Type	Efficacy [lm/W]
Incandescent bulb	16
CFL	60
LED	80



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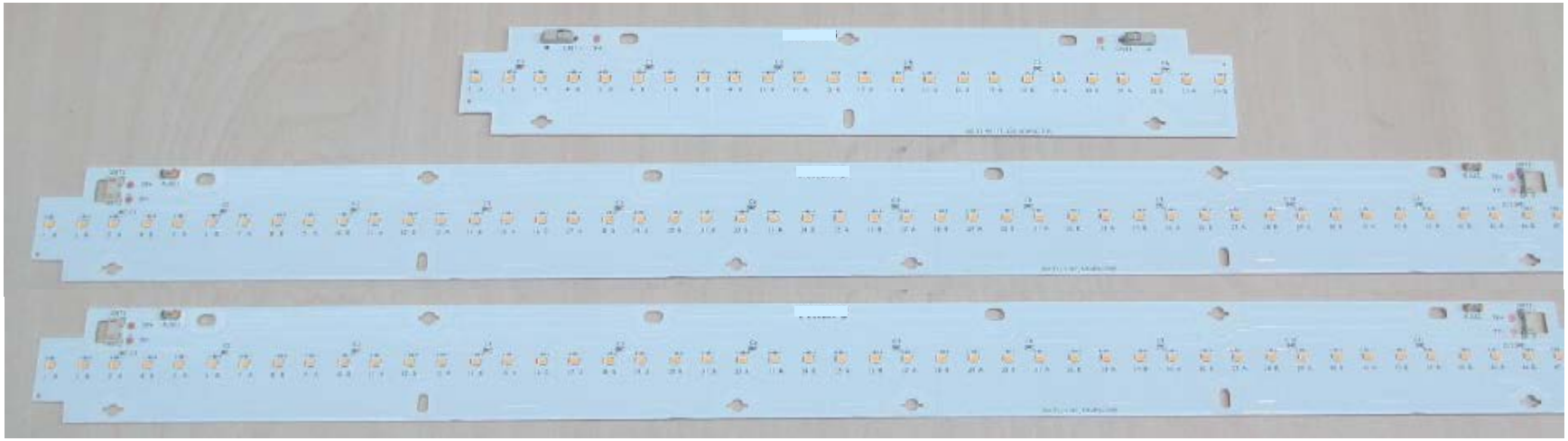
Optimized Drop in Solution

Consistent flux, V_f, color with configurable voltage, LED count and pitch

- Kits in the form of L2 boards
- Provide fully integrated solution for customers at precise color point, flux and power draw



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Flexible Substrates Enable Unique Fixture Designs

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Directional Lamps Require High-Flux Density

Multi-die mid-power emitters reduce LED count & enable narrow beams

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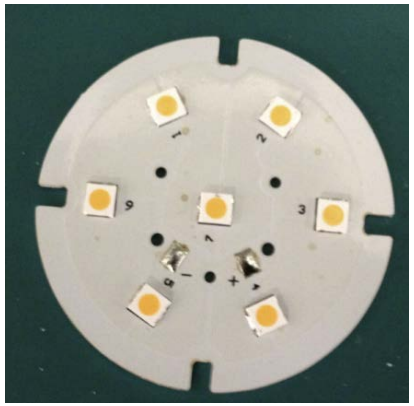
LUXEON 3535 2D & LUXEON 3030 2D Reduce LED Count

Hot targeted 6V QFN LED in industry standard footprint provides 100 lm per emitter @ 135 lm/W to enable efficient, cost effective designs







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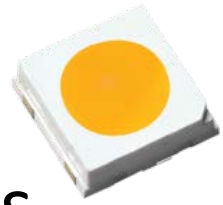


High efficacy driving indoor area applications

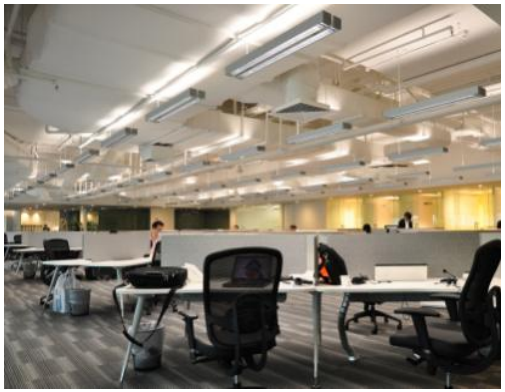
Latest technology LUXEON 3535L emitters achieving >175lm/W

Troffer

2014 LED TAM: $412 M/yr
Incumbent: Fluorescent

TLED

2014 LED TAM: $177 M/yr
Incumbent: Fluorescent: T12, T8, T5



End User Needs

- Large Area Coverage > 100 ft^2
- Comfort/Productivity
- Attractive skin tones
- < 1 Watt / ft^2 (CA Title 24)
- Low glare
- Uniform light distribution

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Enabling Next Generation TLEDs

Solution	T8 (4’)	T5 (4’)	TLED (4’)
Wattage	32 - 40 W	25 - 28 W	10 - 20 W
Source efficacy	70 – 85 lm/W	96 - 108 lm/W	100 - 155 lm/W
CRI	70 - 85	70 - 85	70-90
Total Lumens Out	2750 - 3000 lm	2400 - 2700 lm	1500 - 2000 lm
Lifetime	24 – 40K hrs	30K hrs	50K hrs

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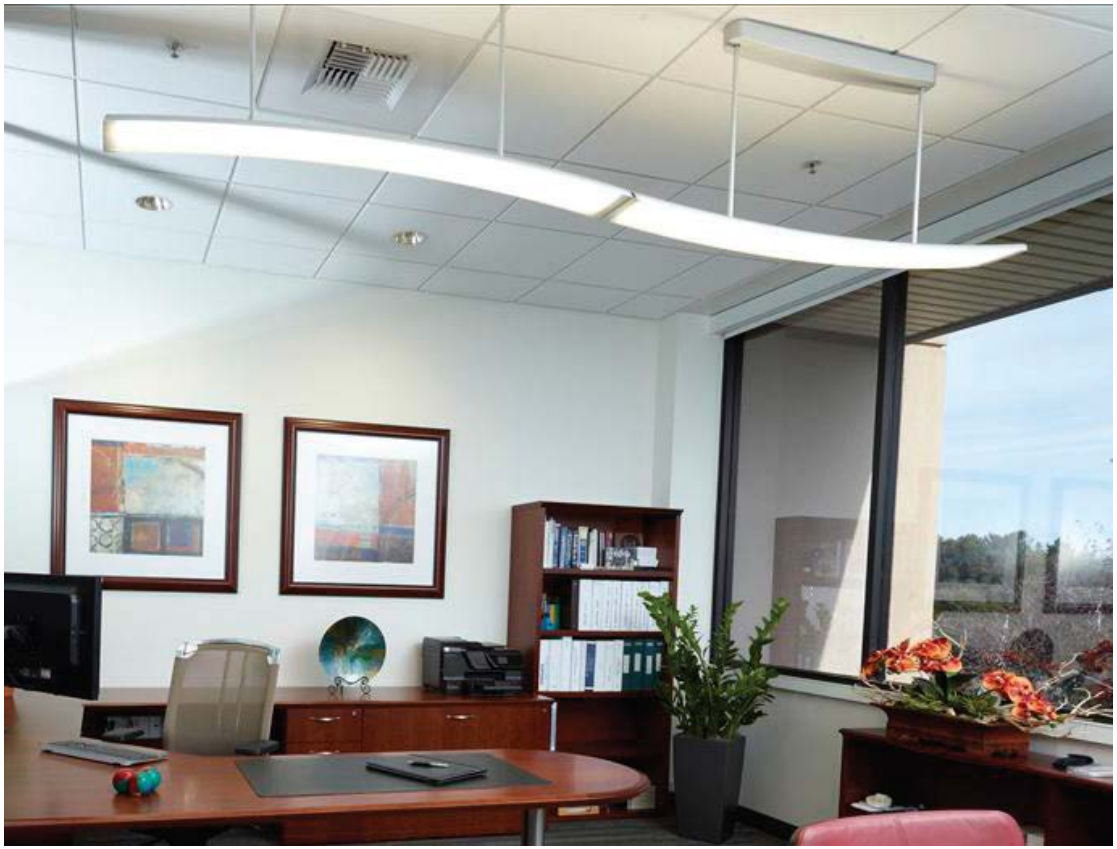
LUXEON 3014

Small Form Factor Enabling Unique Designs

Thin package to help achieve a smooth lighting appearance



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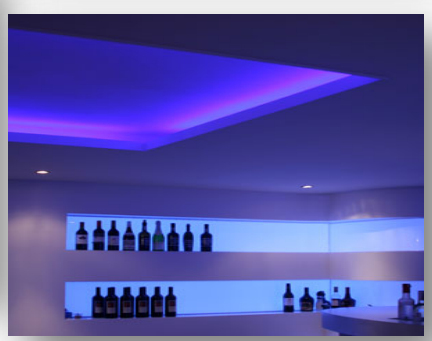
Enabling Next Generation Applications

Reliable, long life LED emitter and L2 solutions

Wall Grazer

Under Cabinet & Cove



T5 Replacement LEDs

Freezer Display

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Thank you