Le Rôle de l'Electronique dans l'éclairage à LED

23 Avril 2009

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Lighting solutions

Agenda

- Introduction : Lighting & Energy
- LED market adoption trend :
  - Master application roadmap
  - Market figures
- Focus on General Lighting
  - Application breakdown
  - Quantitative view
- Role of electronics
  - Value chain
  - System challenges and solutions
  - 2 concrete examples

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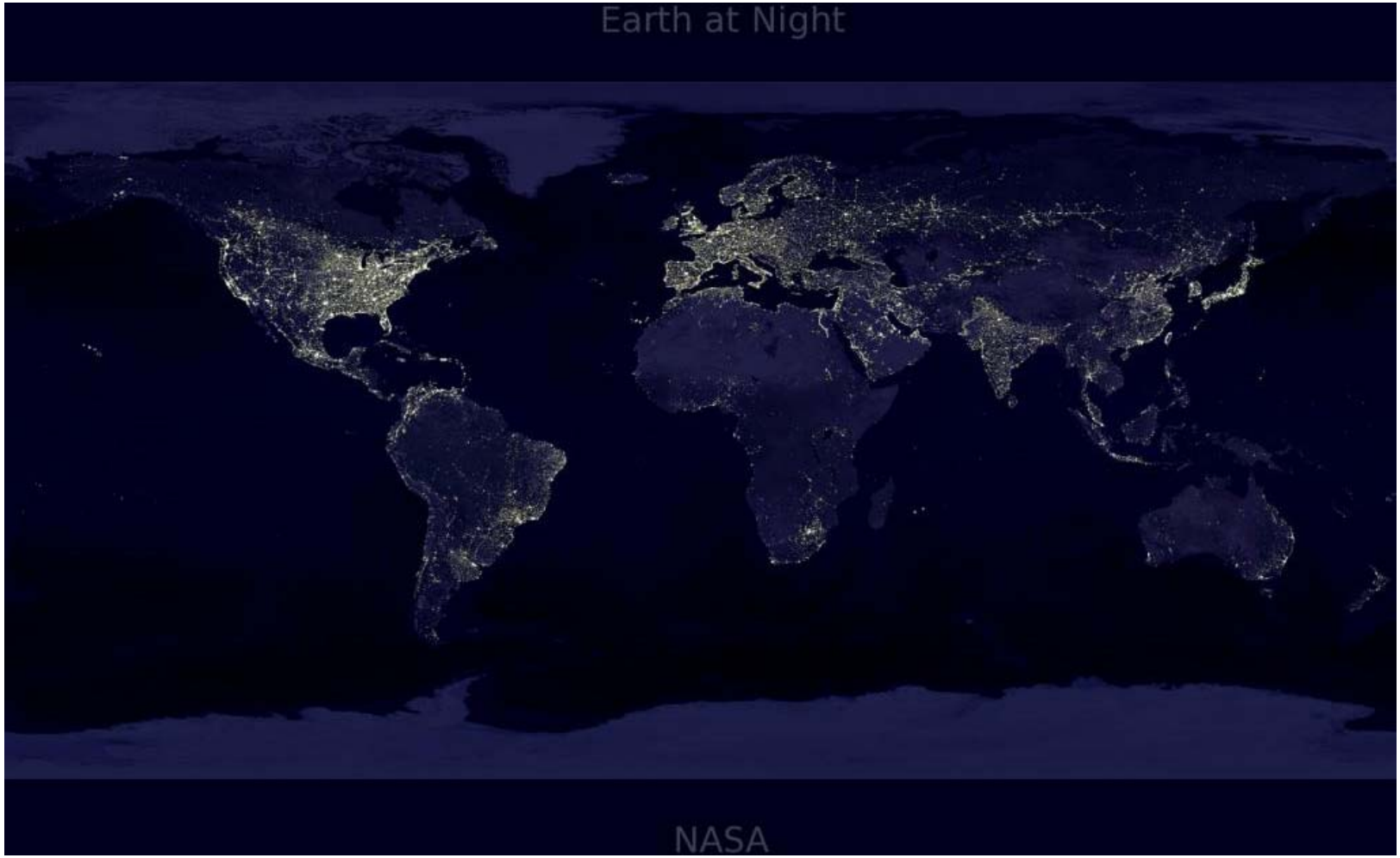
Notre planète, la nuit, vue de l’espace



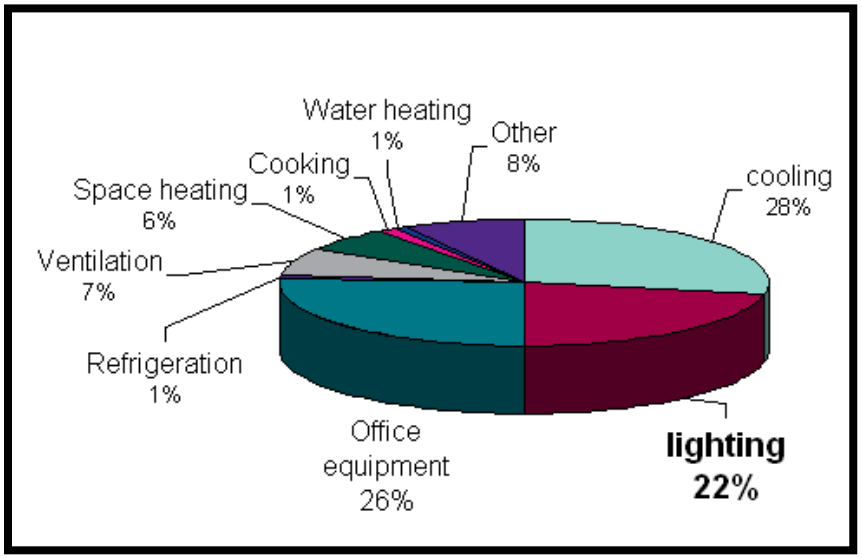
Yearly Energy Consumption (TeraWattHour)

Global Energy Consumption: 124,400

Electricity: 17,080 (14%)

Residential Electricity: 5,200 (4%)

Consumer Electronics: 700 (0.6%)



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Multiplication and acceleration :
Master application roadmap











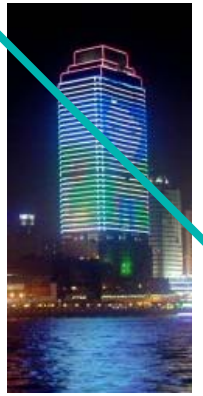




1990s 2000s 2005… 2010s…

Multiplication and acceleration :

CE goods create the initial high volume demand



2005…

2010s…

Multiplication and acceleration :
and enables deployment into Lighting application
















1990s

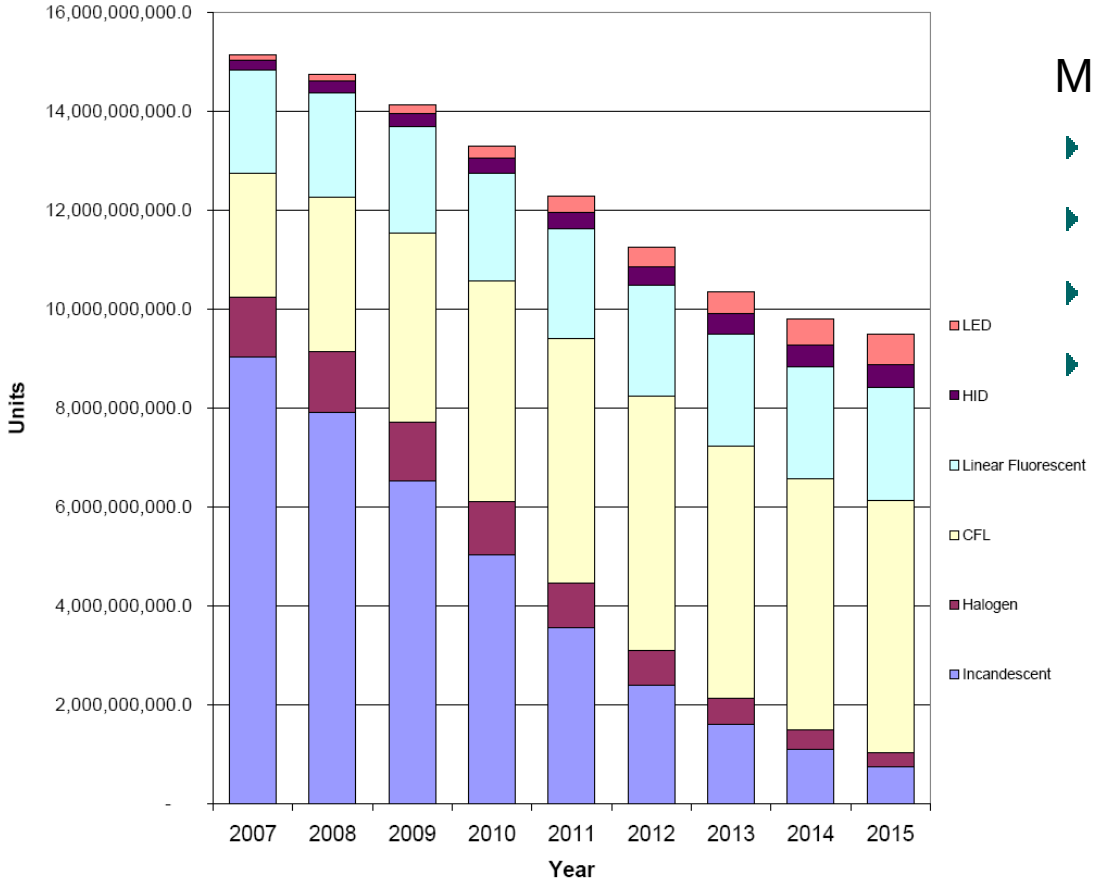
2000s

2005…

2010s…

Lighting Market Outlook (excluding CE goods)

Global Market Lamps



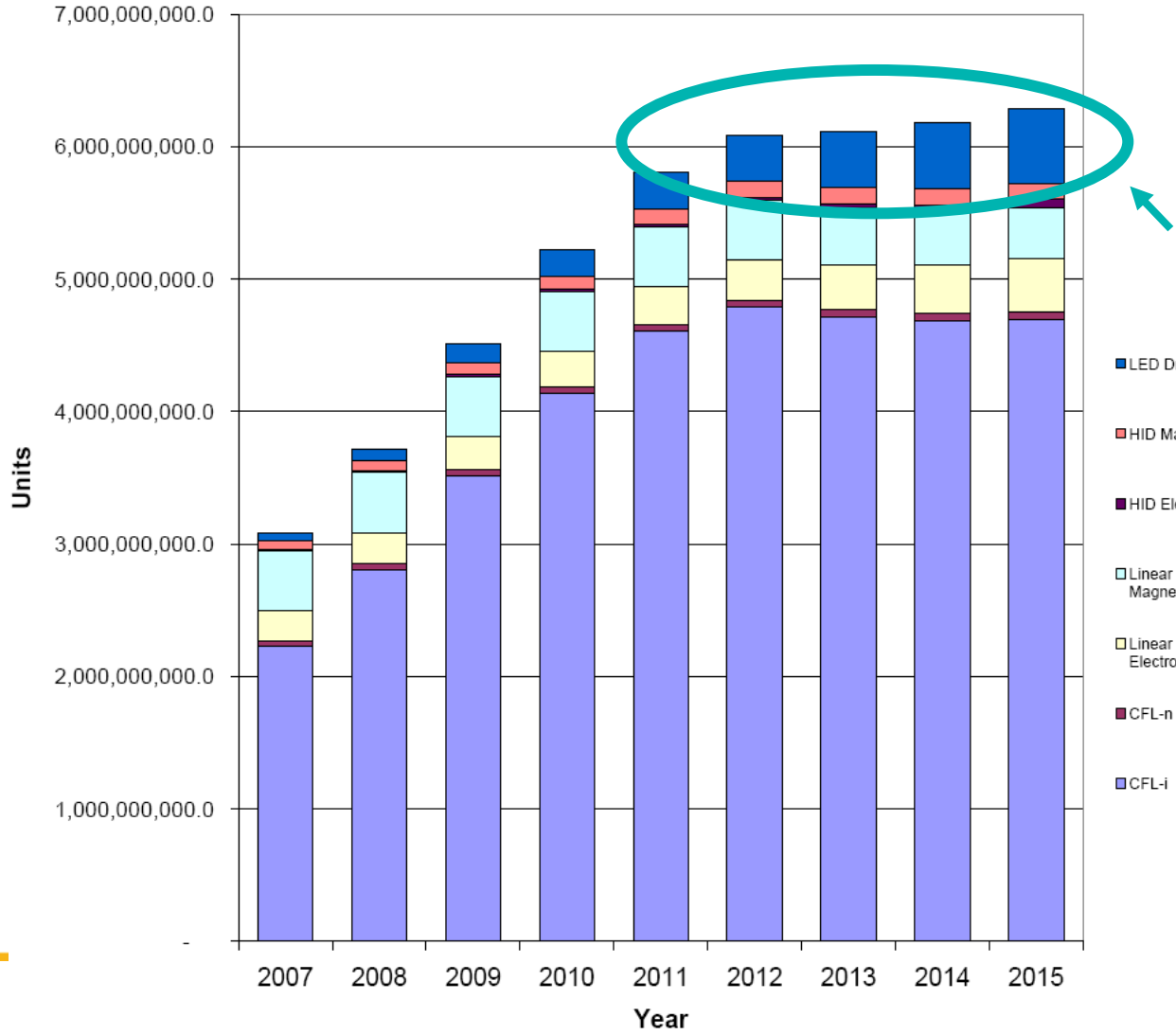
Market for

- Incandescent lamps declining
- CFL strong growth (2007 – 2012)
- **LED lighting starts to grow**
- HF-TL and HID growing

Source: Datapoint Research, June 2008

Lighting Market Outlook (excluding CE goods)

Global Ballast & Driver (ie : electronics)



CAGR:

- CFLi 9.7%
- HFTL 7.4%
- HID el 21.4%
- **LED 32.6%**

Source: Datapoint Research, June 2008

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Focus SSL Applications

Bulb replacement – SSL retrofit

Philips Solid-State Lighting Solutions

Lemnis Lighting

Cree Lighting Fixtures Inc.

Retail display

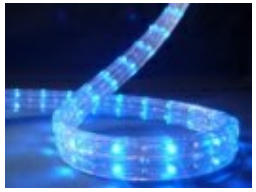
Architectural lighting

Hospitality & Residential

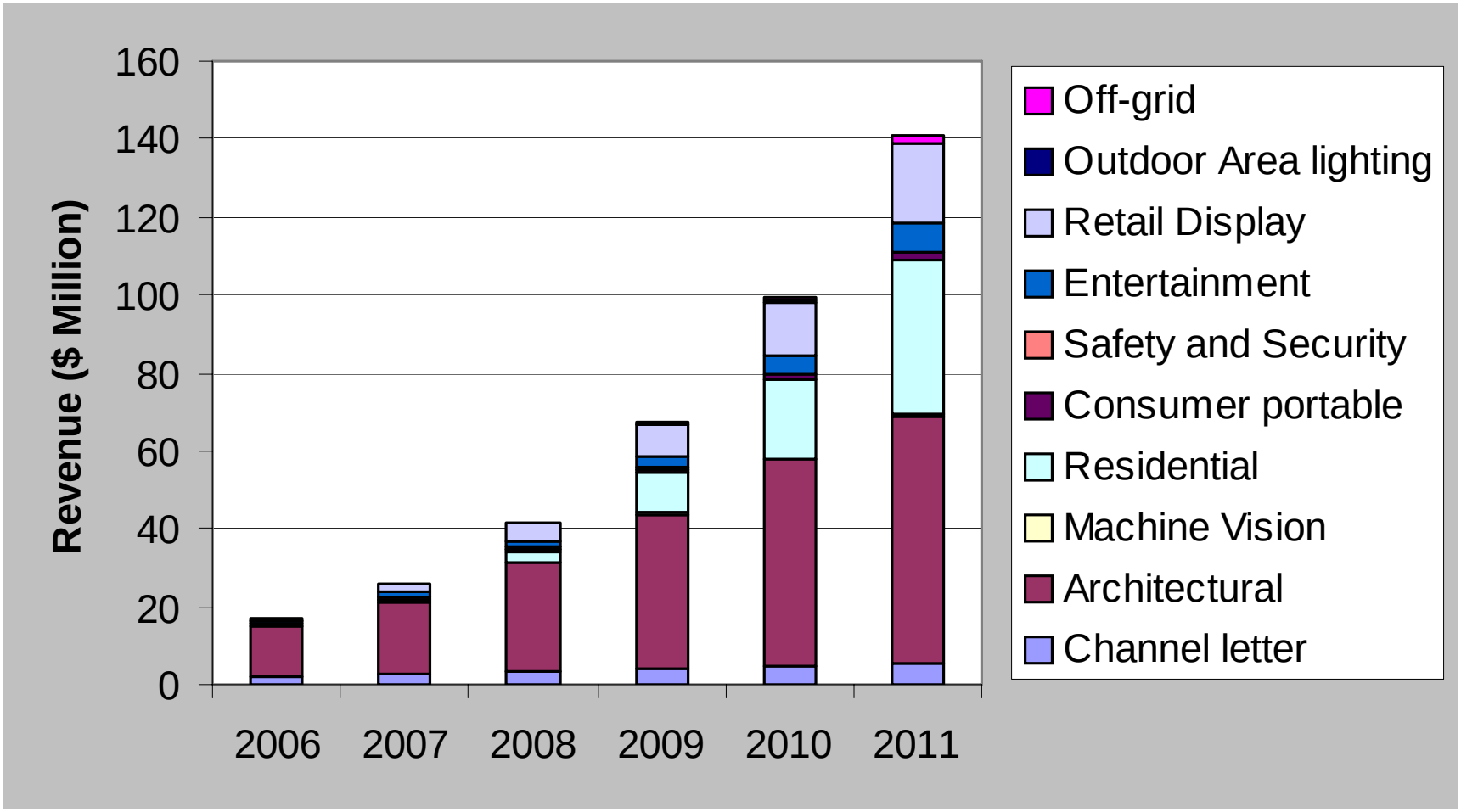
Outdoor & Street Lighting

Beta LED

Channel Letter & Contour



SSL Lighting driver IC market



CAGR is 52%

Challenges for SSL Market

- High initial cost
- Other alternatives for energy efficiency (e.g. CFL)
- Consistency of color/binning issues
- Need to provide a complete lighting solutions with ease of installation
- Adapt to standard electrical interfaces and controls
- Realistic claims of performances (learn from CFL)
- Development of standards (Energy Star)
- Need widespread base of lighting fixture designers and engineers who understand LEDs and driver electronics
- Need for high-efficiency light engine/fixture design

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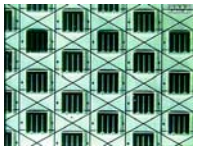
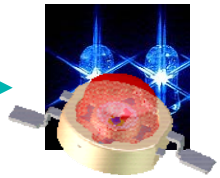
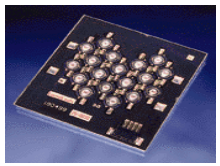
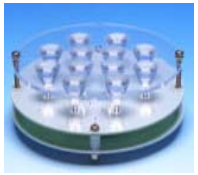
Les semi-conducteurs dans la chaîne de valeur du Solid State Lighting

Level 0	Level 1	Level 2	Level 3	Level 4	Level 5
					
Wafers / dies	Packaged LEDs	LED arrays on board incl. connects	Modules, incl. driver, controls, secondary optics	Luminaires / fixtures	Systems consisting of many luminaires, overall controls

Les semiconducteurs pour des solutions à LED performantes et innovantes

Les LEDs ne peuvent fonctionner sans circuit intégré

- Convertisseur : indispensable pour assurer l'alimentation électrique des diodes
  - AC/DC ou DC/DC
  - Source de courant plutôt que source de tension
- Contrôles pour compenser les faiblesses des diodes
  - Dérive en flux et couleur en fonction de la température et du temps
  - Dispersion dans les lots de fabrication (binning)

Les semiconducteurs offrent de multiples possibilités au niveau du SYSTÈME

- Optimiser la performance des LEDs et l'utilisation du luminaire
  - Capteurs de lumière
  - Mémoire embarquée
- Programmer des effets lumineux dynamiques
- S'intégrer aux infrastructures existantes ou en inventer de nouvelles
- Commande / Contrôle de la lumière

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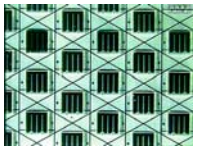	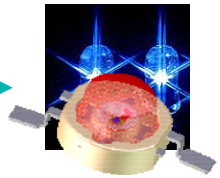	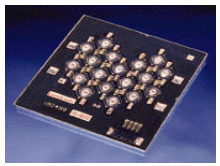	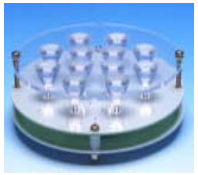		
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ESD protection

Sensors (T°, Light)

Semiconductors

LED driver, sensors & control modules

Power modules

Qu'y a-t-il dans une lampe à LED?

Exemple

Un convertisseur AC/DC, pour fournir aux diodes une tension correcte

AC/DC

Module de contrôle

Control

T°

Capteur de température

Sense

I^2C

USB

ZigBee
DMX
Dali

Des interfaces

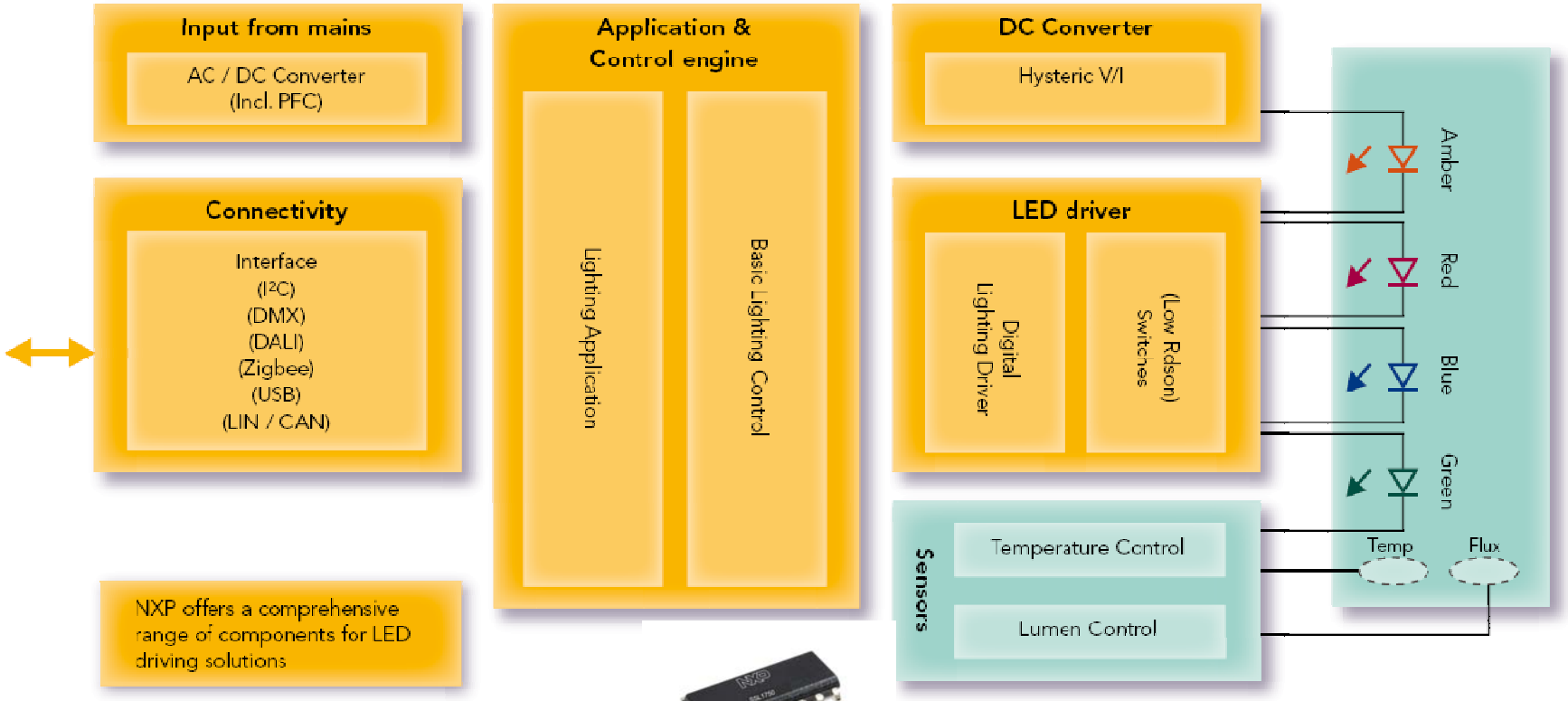
De la colorimétrie

Une ou plusieurs LED

Semiconducteurs

General Lighting SSL Architecture

NXP offers a comprehensive range of components for LED driving

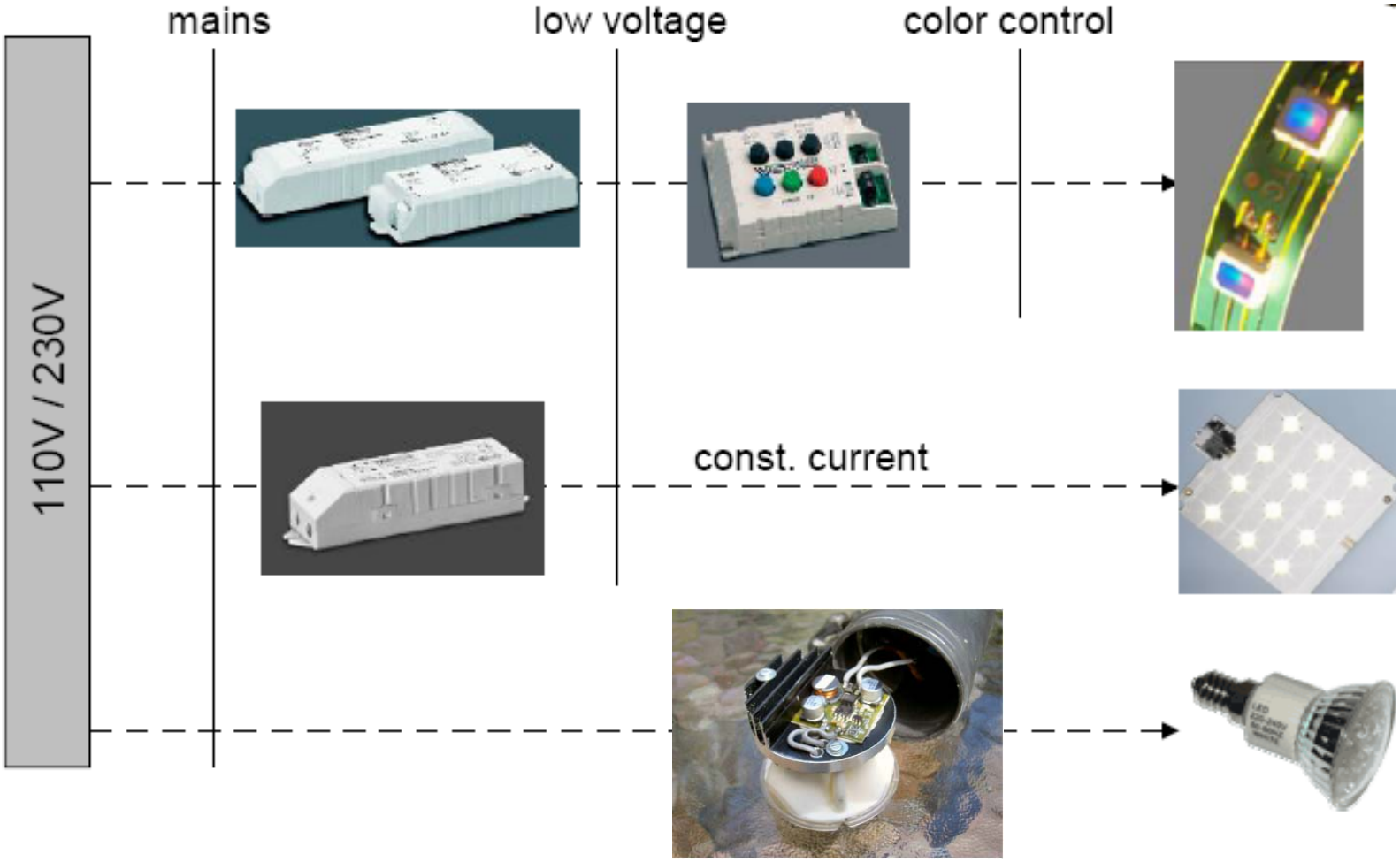


LCP24xx chip shot

AC/DC LED drivers
Microcontrollers
Power Discretes

DC/DC LED drivers
Connectivity – Interface products
Low Power Discretes

Different ways to drive LED's



Application Breakdown of LED driver solutions

DFGF#Gulyhu#Dssdfdwlrqv

- Incandescent Replacements
- Traffic & Info Light Systems
- Signs & Displays
- Commercial / Residential Lighting
- Multi-color primary stage
  - Decorative Lighting
  - Architectural Lighting

GFGF#Gulyhu#Dssdfdwlrqv

- Portable (Cell phone, flash lights)
- Automotive Interior/exterior
- RGB Backlight (LCD TV)
- White LED Back lighting
- Multi-color second stage
  - Architectural Lighting

2 concrete examples

- **LED retrofit lamp**

- **Streetlighting**

A bright idea for dimmable LED luminaires

Hospitality & Residential Lighting : Mains LED drivers

Feature	Benefit
Efficient power conversion	Maximizes energy efficiency
Supporting majority of existing dimmers	Supporting existing lighting infrastructure (TRIAC & transistor)
Reduced component count - Integrated 650 V MOSFET	Low system costs
Extensive range of built-in protection features	Aligned with safety regulations

Comparison 40W incandescent – 7W LED lamp

Key applications

- Retro-fit LED lamps
- LED ballasts
- Signage
- Contour lighting
- Commercial lighting e.g. cabinet or freezer lights

A bright idea for dimmable LED luminaires

- Highly efficient current control for dimmable mains LED driving
- Easy migration to existing lighting infrastructure (TRIAC and transistor dimmers), supporting majority of available dimming solutions
- Suitable for different power requirements:
  - SSL retrofit (e.g. GU10) 3W - 8W
  - LED modules (e.g. LED spots, down lights) 8W – 15W
    Separate power supply, not close to LED's

- High integration level:
  - Less external components needed
  - Ideal for small form factor applications with closed casing
  - Offering non-isolated (buck) and isolated (flyback) solution in one chip
- Reliable and safe thermal solution via thermal enhanced package
- Aligned with regulations on safety and power factor

The power behind vibrant solid-state lighting

LED Street & Road Lighting
Driver based on NXP IC's SSL1750 & UBA3070

Feature	Benefit
Efficient power conversion from mains	Maximizes energy efficiency and minimizes form factor through reduced heat generation
Accurately-controlled current through LEDs	Allows dimming to save energy when the street is deserted
Integrated PFC (Power Factor Correction)	Meets required power factor and harmonic distortion regulation above 25 W

What if you could provide the right light and driver electronics to reduce energy wastage?

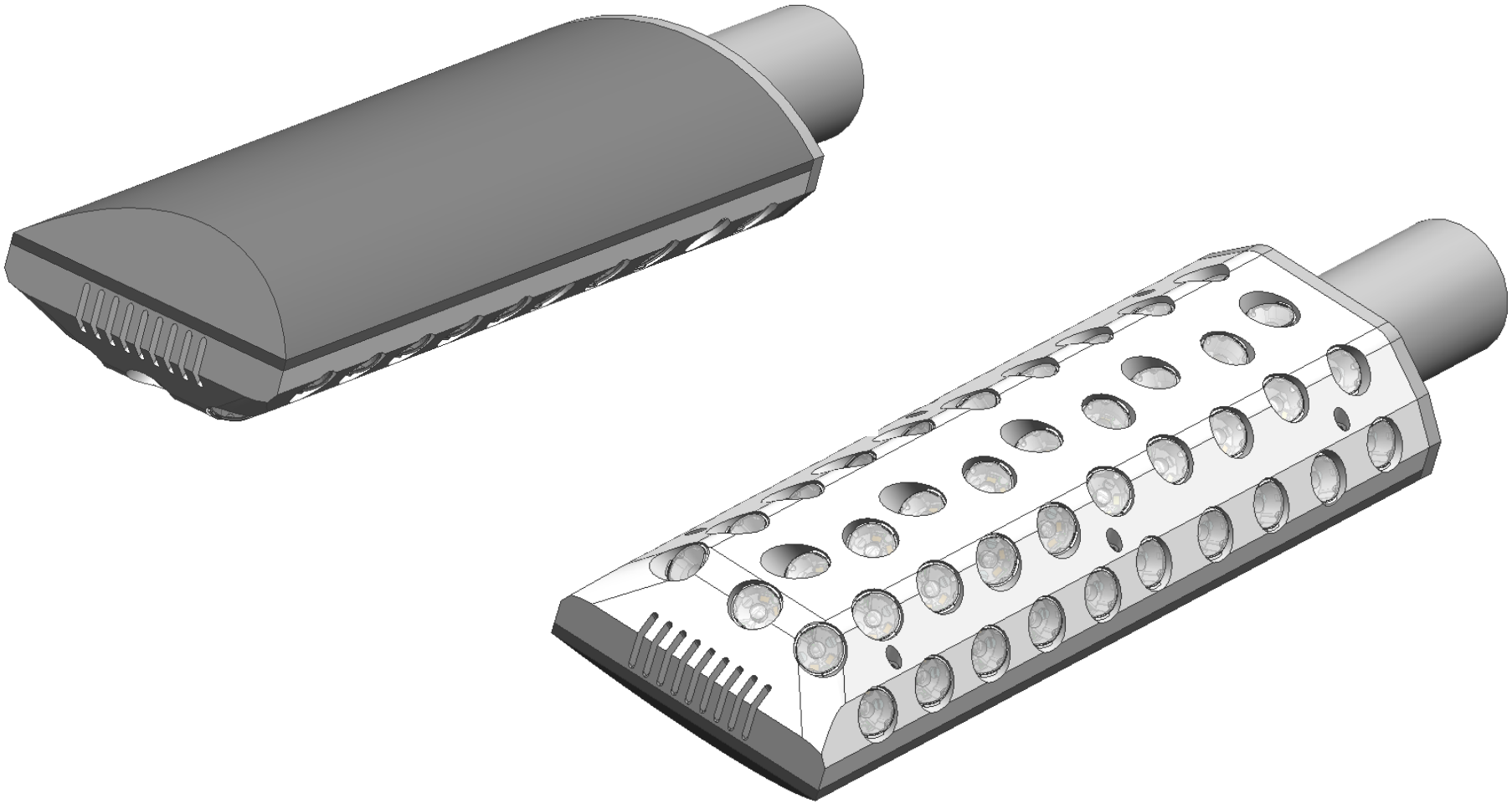
Comparison HPL 125W – 65W LED lamp

Energy saving ***Up to 50%***

$C0_2$ saving ***115 kg $C0_2$ per lamp/yr***

*Based on 0.51 kg / CO_2 kWh

LED street light design (concept)



Performance street lamps

Luminaire :

Philips HG 20380125G “cobra head”

Lamp:

High Pressure Mercury lamp HPL 4PRO 125 W

CCT 4200 K

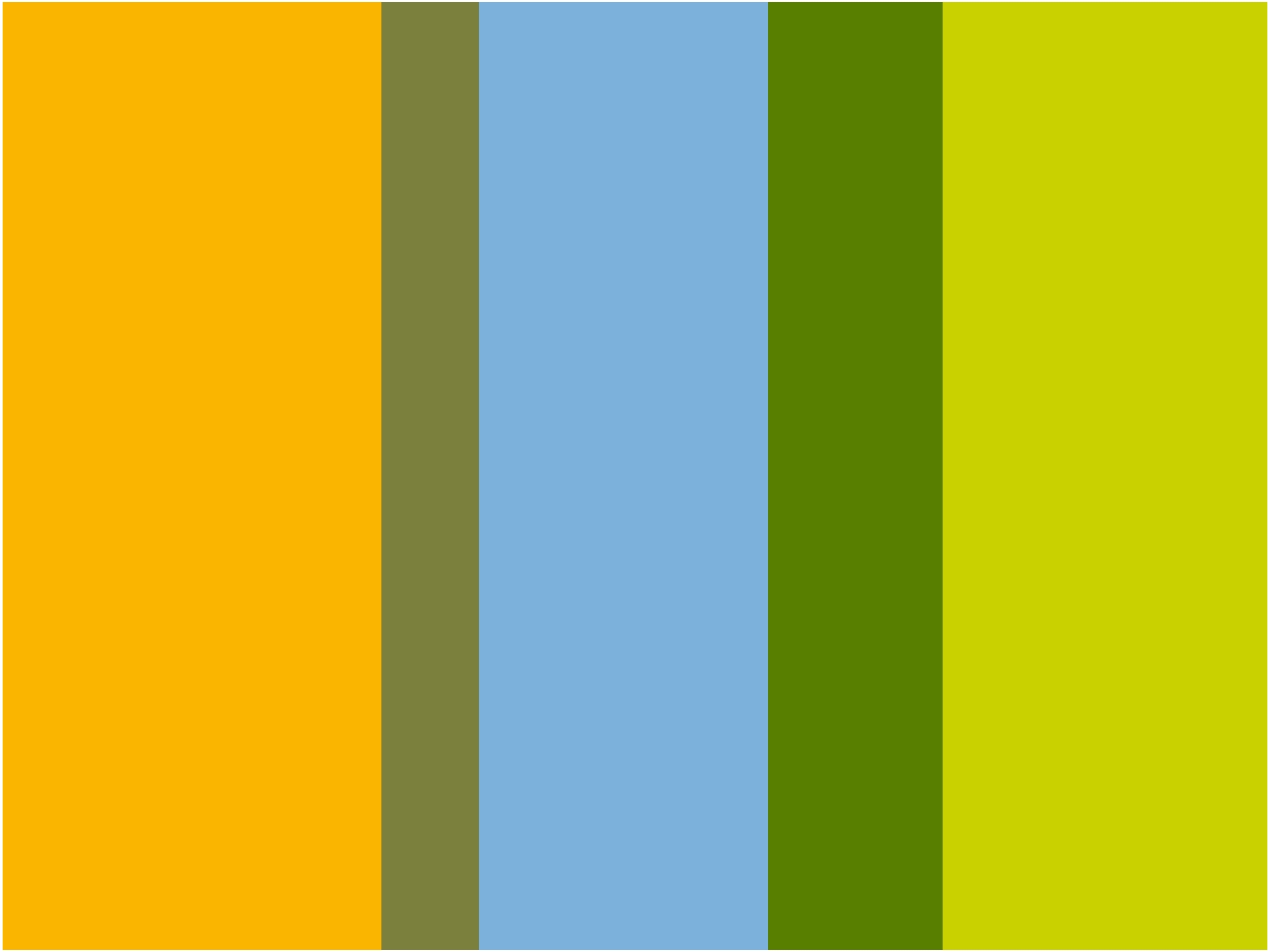
Lifetime 16.000 Hours

lamp type	HG203 HPL 125W	LL demo	improvements
Flux (lm)	4340	3424	-21%
System power (W)	138	64	-53%
Efficacy (lm/watt)	31	54	+70%
Average lux	14	14	
Utilization factor	0.0032	0.0041	
lux/watt	0.10	0.22	
U0	0.23	0.40	

Driver design for street lighting

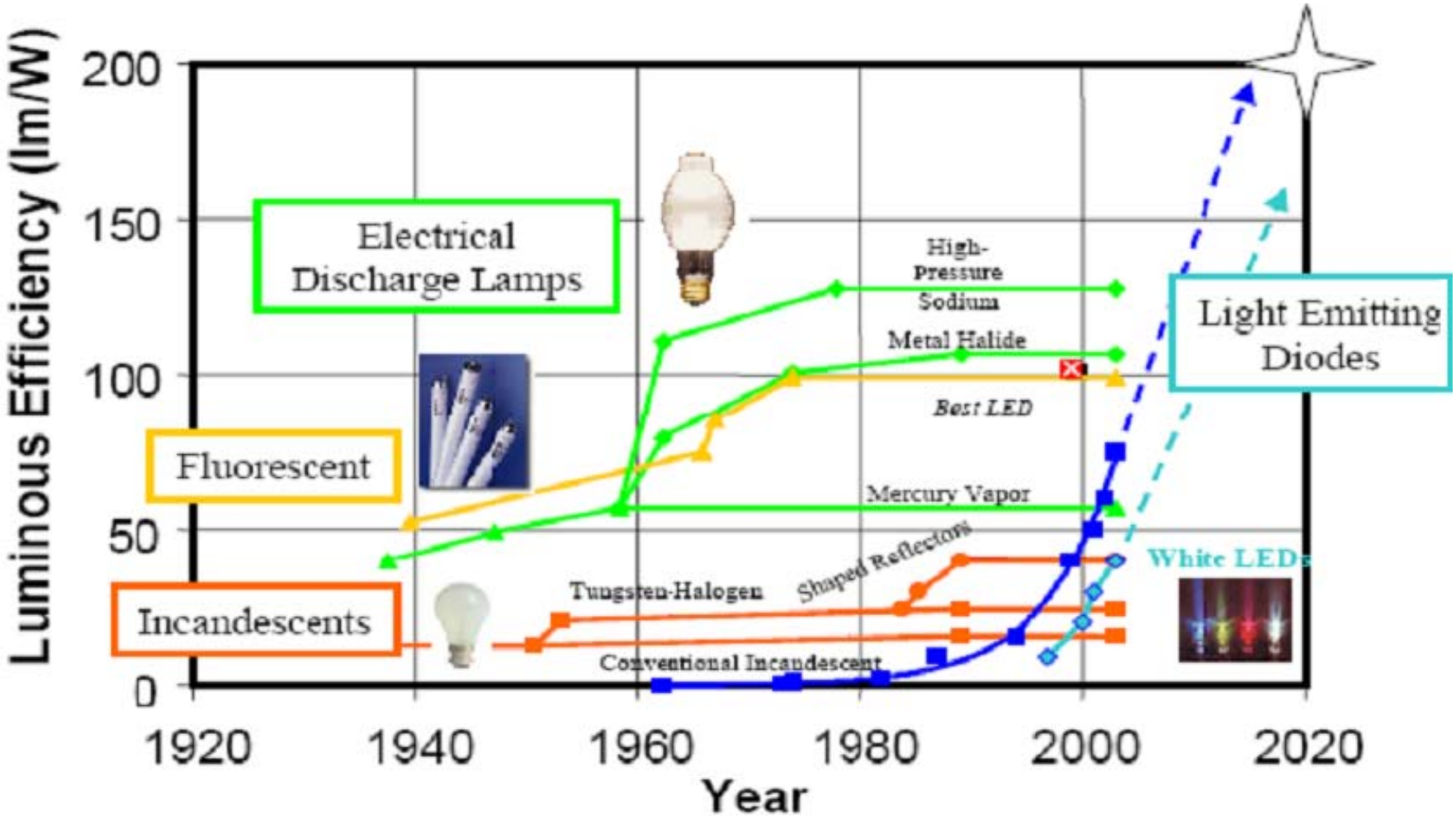
Main system specification aspects to be considered

- Outdoor product (air contaminations, >IP23)
- AC mains supply (230V – 275V / safety IEC 60598)
- Danger for lightning strokes (mains spikes and surges / IEC1000-4-5)
- Ambient temperature (-20ºC - +40ºC)
- Mechanical stress (bumps, vibrations / IEC 68-2-Fc)
- Long lifetime (> 30.000hrs)
- Energy consumption (Energy star)
- Material cost
- EMC / CISPR 15 - Standards
- Fault detection and communication.
- Maintenance cost
- Switch on/off procedure/control or Dimming procedure/control.
- Optical / temperature feedback

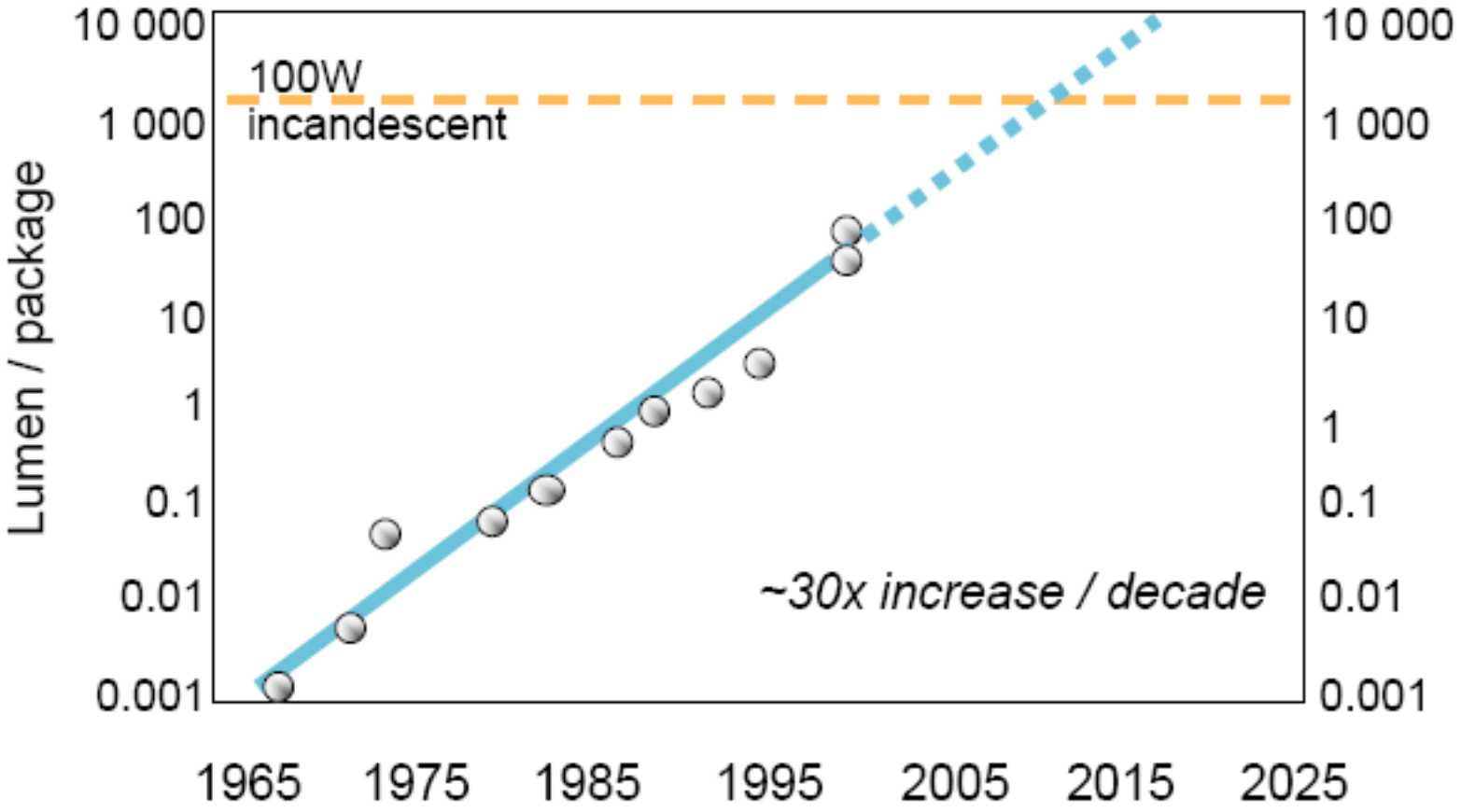


Back up

L’évolution des performances des technologies d’éclairage



Performance des LEDs: progrès constants



Source: Haitz' law

Coût du lumen : vers des marchés de masse

LEDs blanches