

Recent Developments in LED Lamps & Applications

ELCOMA LED Conclave
3rd May 2010

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Introduction & Contents

1. Shifting Applications of LEDs in General Lighting
2. Recent Developments in LED Retrofit Lamps
3. Myths and Precautions when Specifying LEDs
4. Emergence of Standards for LED Products
5. Havells - Sylvania Actions to support Indian market

1. Market Shift in LED Applications

LUMINANCE

MARKET SHIFT →

ILLUMINANCE

(Light source is viewed directly)

- The earliest LED applications
- Low brightness devices
- Usually coloured / colour changing

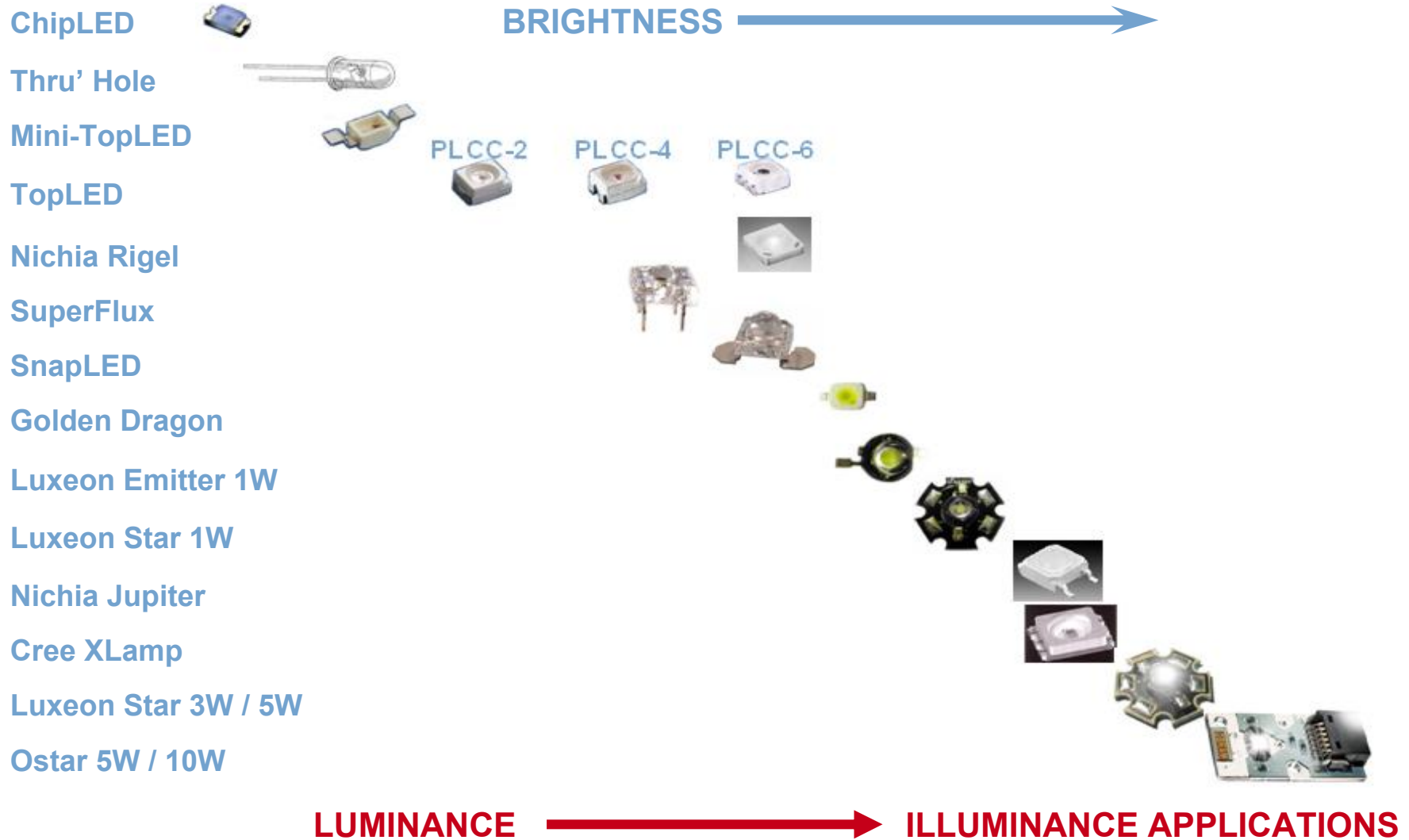


(Light source projects out a beam)

- Latest developments for LED lighting
- High brightness devices
- Primarily white for general illumination






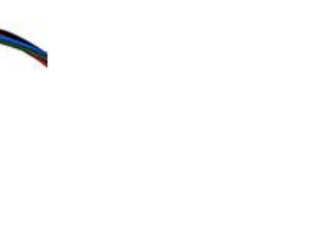











LED Package Evolution vs Brightness



Expanding Applications for Luminance

	Signage	Decorative	Marker light	Architectural	Signalling
LED LAMP TYPES	<i>LightFlex</i>	<i>Low Flux Rod/Cable</i>	<i>LED Bar/Round MicroLynx</i>	<i>Linearlight LED Bar</i>	<i>Special Arrays</i>
					
LED APPLICATION EXAMPLES					
					

Expanding Applications for Illuminance

	General	Accent&Display	Architectural	Emergency	Projection
LED LAMP TYPES	<p><i>LED Array</i></p> <p><i>Retrofit Bulb</i></p> 	<p><i>Hi-Flux Module</i></p> <p><i>Retrofit Bulb</i></p> 	<p><i>Strip Module</i></p> 	<p><i>Low-Level</i></p> <p><i>General Light</i></p> 	<p><i>Hi-Flux /</i></p> <p><i>Flash LED</i></p> 
LED APPLICATION EXAMPLES	 	 	 	 	 

2. Recent Trends in LED Retrofit Lamps



LED retrofits started with very low power:

- Only suitable for decorative effects
- Typically popular in coloured versions
- Light output too low for general illumination



GLS Bulbs are being phased out in EU:

- Base-level halogens may be next in line
- Not all types can be replaced by CFL
- e.g. CFL Reflectors are not optically efficient
- CFL Ball / Candle are often too large



This is fuelling LED Retrofit Innovations:









- LED Reflectors show real optical excellence
- LED Ball / Candle can be smaller than CFL
- Full family of true LED retrofits now emerging
- Havells-Sylvania is playing leading role

RefLED ES50 – First True Halogen GU10 Retrofit



- Exclusively designed by Havells-Sylvania R&D Engineers
- World's first genuine retrofit to match 50W Halogen beam performance
- Fits within IEC Outline Dimensions for Halogen Ø 51mm GU10 lamps
- 50 lm/W Efficacy realises 90% energy saving against basic halogens
- Long lifetime of >15,000 hours (while achieving lumen maintenance > 70%)
- High quality warm-white light, Colour 830 = 3000K, Ra >80
- Universal Input 100-250V for global sales & not affected by voltage dips

What About Lamps for New Luminaires?

LAMP SITUATION			LED SITUATION	
	Standardised lamp range!	The Light Source		Vast choice and no clear specification
	Standardised lampholder!			
	Can be fully integrated!	Installation		Thermal paste + Soldering + Wires + Screws
	Not needed!			
	Can be fully integrated!	Optical control		Develop your own special lens optics
	Not needed!	Thermal control		Engineer your own heat sink designs
	Standardised Drivers!	Electrical Supply		Choose from dozens of different LED drive currents and find a suitable electronic driver

Practicalities of Current LED Luminaires

- Only top ~10% of Luminaire makers are truly competent in LEDs
 - Baffled by endless choice of LEDs and changing specifications
 - Do not always understand thermal / optical challenges
 - Uncertainty surrounding the driver and resulting LED life
 - Their chosen LED is often obsolete after a year of production!
 - Result : US DOE found that most LED fixtures fail to meet claimed spec
 - Customer suffers, and full potential of LED is not being realised
- Long-Term Perspective of Sealed-for-life Luminaires
 - Some LED fixtures always fail early : cannot be repaired like a normal lamp
 - No possibility to change colour, lumens or beam angle as with normal lamps
 - LED Efficacy also rising at an impressive rate
 - Who wants to buy a sealed for life fixture and be stuck with it for 20 years?
 - Better energy savings possible if the LEDs inside could be upgraded over time
- Conclusion : Combine LED performance with flexibility of a lamp!

The Dilemma of LED Lamp Developments

- Existing LED Lamps only available in retrofit formats.
- Established lamp caps offer no thermal connection to the luminaire body
 - provide only an electrical & mechanical interface.
- All heat sinking must be handled within the lamp itself.
- Heat sink size is limited by the IEC maximum lamp outline dimensions.
- This is too small to handle high powers – so LED lamp efficacy decreases as lumen packages increase, due to heat sink saturation!
- Consequence : it may never be possible to replace the higher wattage incandescent / halogen lamps by LED because their self-contained heat sinks are too small to dissipate the necessary LED power.
- Solution : develop a new thermo-electro-mechanical lamp cap which transfers heat its socket, allowing higher power and lumen packages.

Second Generation LED Lamps from Sylvania

- Heat Sinking is displaced to the luminaire body
 - *New format lamp caps for thermal transfer*
 - *Heat sink not thrown away with each lamp change*
- High lumen packages (~ 400-3000 lm when hot)
 - *Only one lamp needed per luminaire*
- High system efficacy (~ 75 lm/W when hot)
 - *Compares well with CFL system efficacy*
- Flexible & Future-Proofed LED Lamp Concept
 - *Lamp is replaceable by more efficient future versions*
 - *Customer can change beam angle / CCT as desired*
- Long-term Stability & Simplicity for OEM & Customer:
 - *Self-contained replaceable lamp with integral optics*
 - *Standardised socket allows upgrade / replacements*
 - *No more fear about LED chips being superseded*

NEW LED LAMP



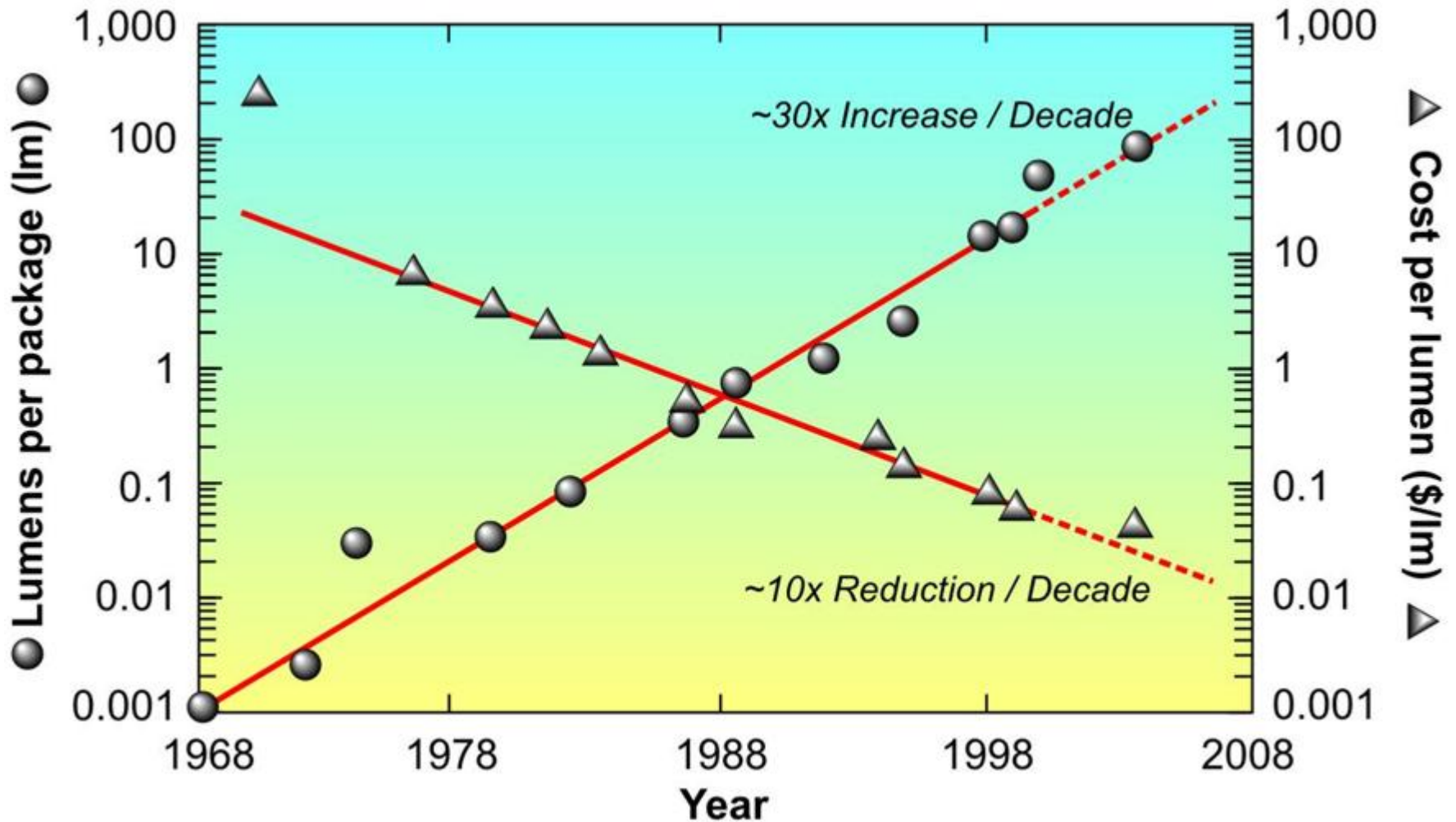
NEW LED SOCKET



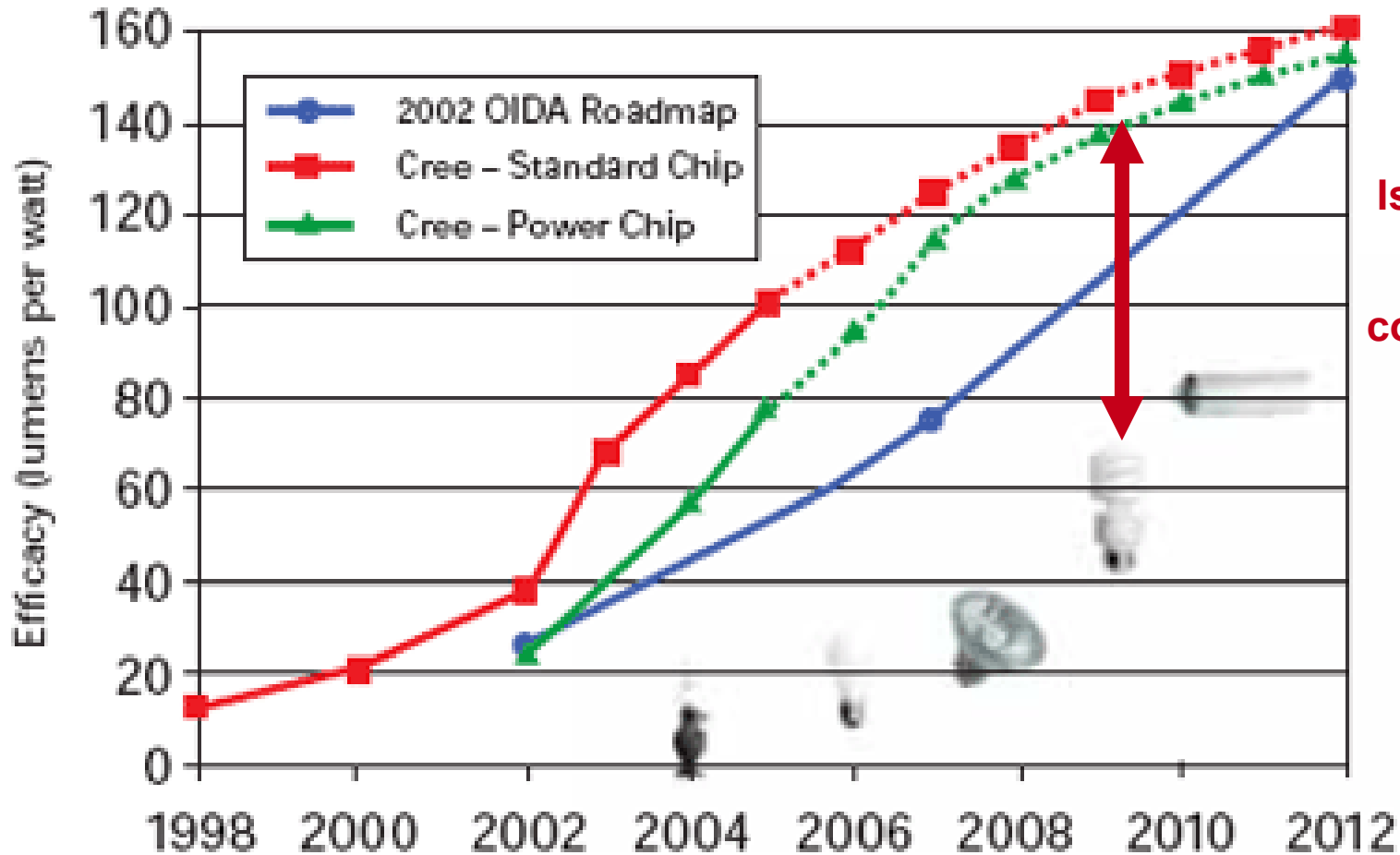
3. Myths Surrounding LED Performance

- **LEDs are the most efficient light sources of the future :**
 - *White LEDs can easily achieve $> 100 \text{ lm/W}$!*
- **LEDs will last a lifetime :**
 - *Because typical life is $> 50,000$ hours!*
- **LEDs are going to supersede all other light sources :**
 - *LEDs out-perform all other lamps on every criteria!*
- **Havells-Sylvania takes a more realistic viewpoint :**
 - *We shall analyse each point in detail during this section.*

Haitz's Law of LED Development

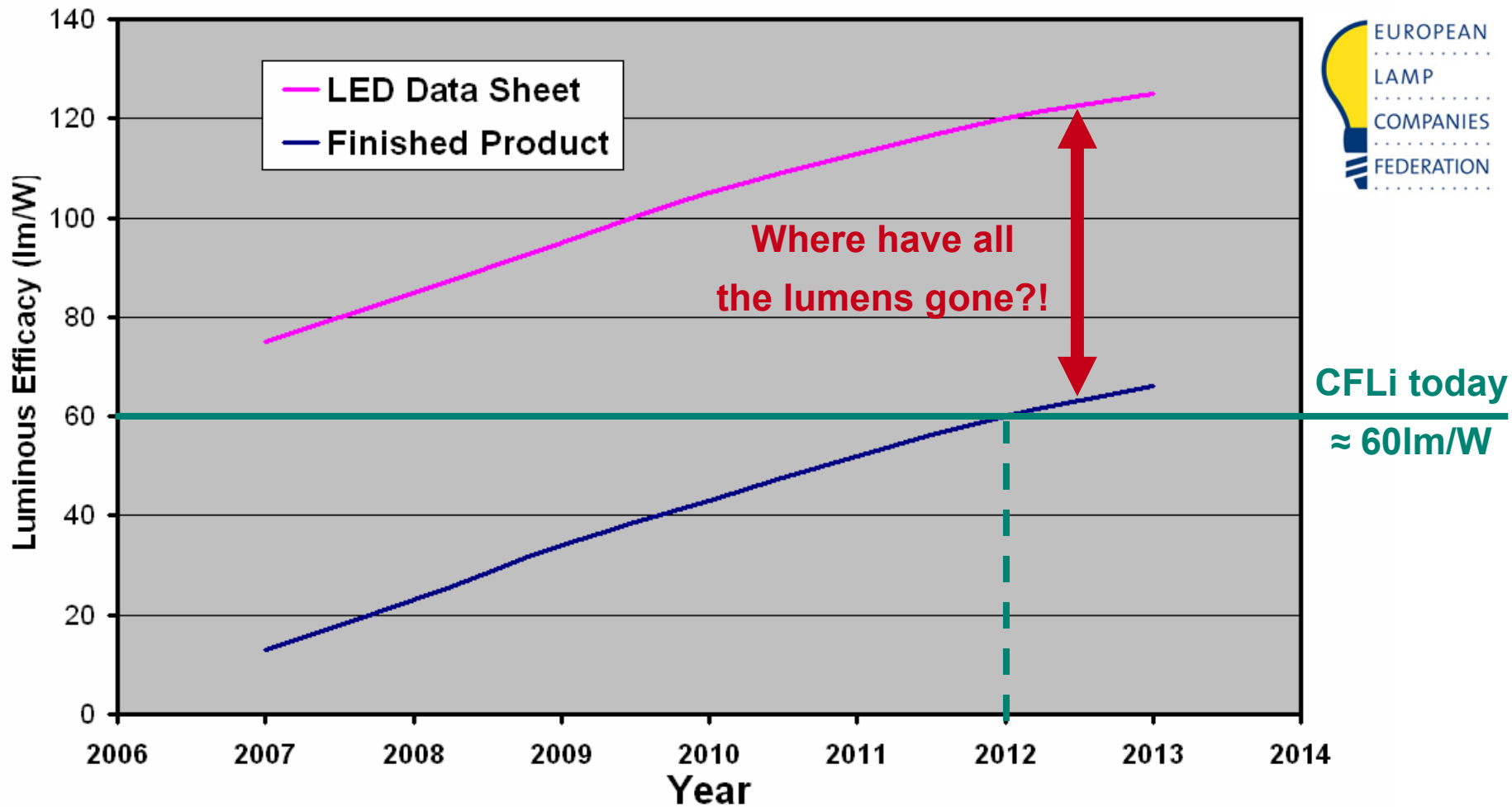


Typical White LED Efficacy Roadmap



Is this really a truthful comparison?

ELC : A More Realistic Efficacy Roadmap



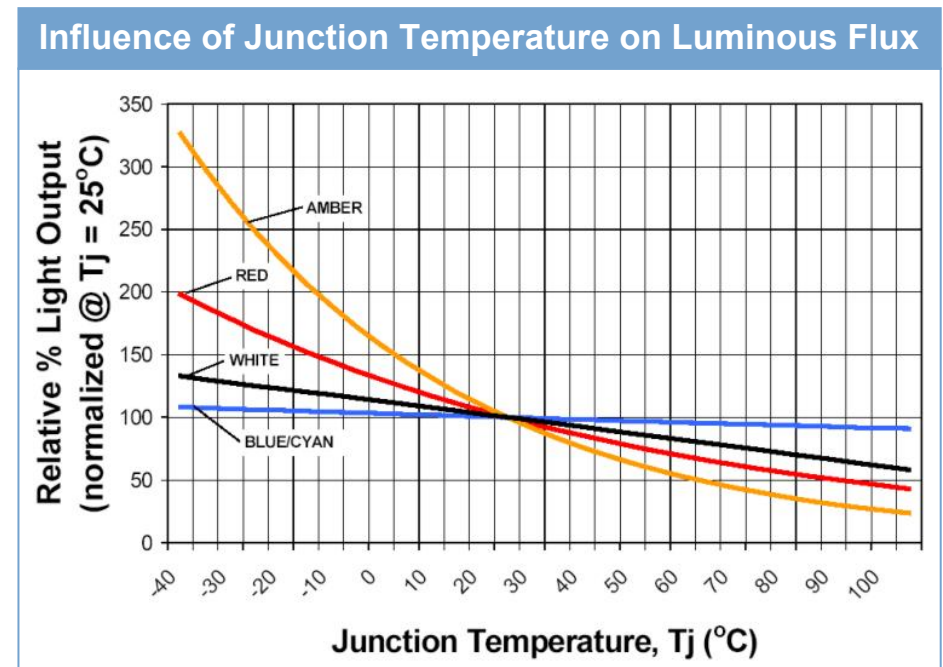
ELC Data : Based on Warm White (3000K) Retrofit LEDi lamp with internal driver

White LED System Efficacy

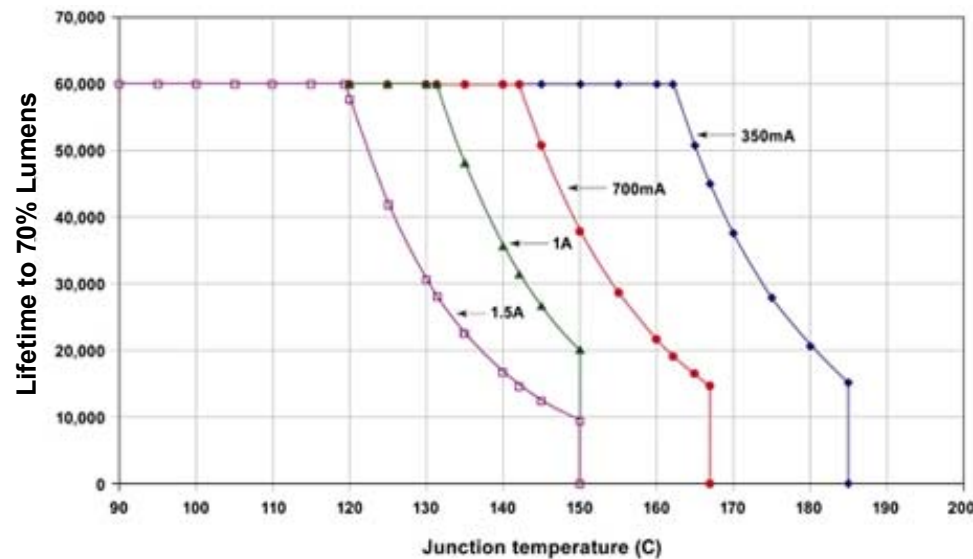
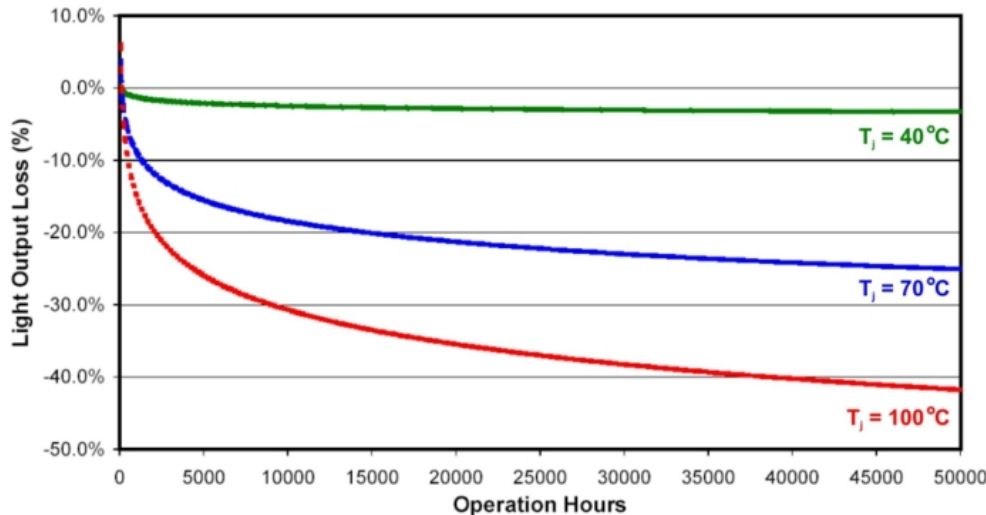
- Efficacy of commercial white LEDs in 2009 = 60-100lm/W
 - Apparently compares well with other energy efficient sources e.g. CFL, Fluorescent, HID
- Efficacy of commercial white LED Lamp/Fixture in 2009 = 20-50 lm/W !
 - LED efficacy decreases considerably in real installations, compared to the raw device specs
- **WHERE HAVE ALL THE LUMENS GONE?!**
 - Light output decreases at real operating temperatures (droop effect)
 - Warm White / Hi-CRI LEDs are 20-50% less efficient than the top performing products
 - Optical losses typically 10-30% in LED lens / diffuser elements
 - Electronic drivers are currently less efficient than for other light sources
 - LED drivers typ. 50% to 85% efficient – c.f. Halogen 95% efficient, HID/FL 80-90% efficient.
- These issues must improved to make LED systems more efficient

LED Thermal Behaviour

- Rated datasheet lumens are always at $T_{\text{junction}} (T_j) = 25^\circ\text{C}$
- This is almost never achieved in real situations
 - Calculate T_{junction} then check data sheet to find out how much the lumens will drop (see chart)
 - $T_{\text{junction}} = T_{\text{heat sink}} + (\text{LED Watts} \times \text{Thermal resistance})$
- At lower temperatures:
 - Temporary increase in flux & efficacy
- At higher temperatures:
 - Temporary decrease in flux & efficacy
 - Lifetime dramatically reduced
 - Above $T_j \sim 120^\circ\text{C}$ irreversible and permanent damage will occur
- Each colour affected differently



LED Temperature vs. Achieved Lifetime



- Wide variety between different manufacturers & operating conditions
- White LEDs rarely fail catastrophically, but by lumen depreciation
- Specification of a good LED plus good thermal control is essential to achieve long life
- Sadly many products do not follow this important advice

The Importance of Through-Life Stability



When to Use LEDs for the Right Reasons

- Industry’s Lamp Portfolio can be likened to a Multi-Dimensional Matrix
- Besides Life & Efficacy, countless other parameters are of importance:

Colour Temperature	Colour Rendering	Colour Stability
Luminous Flux	Run-Up Time	Dimmability
Purchase Cost	Reliability	Temperature sensitivity
Physical Size	Optical Control Property	. . . etc.

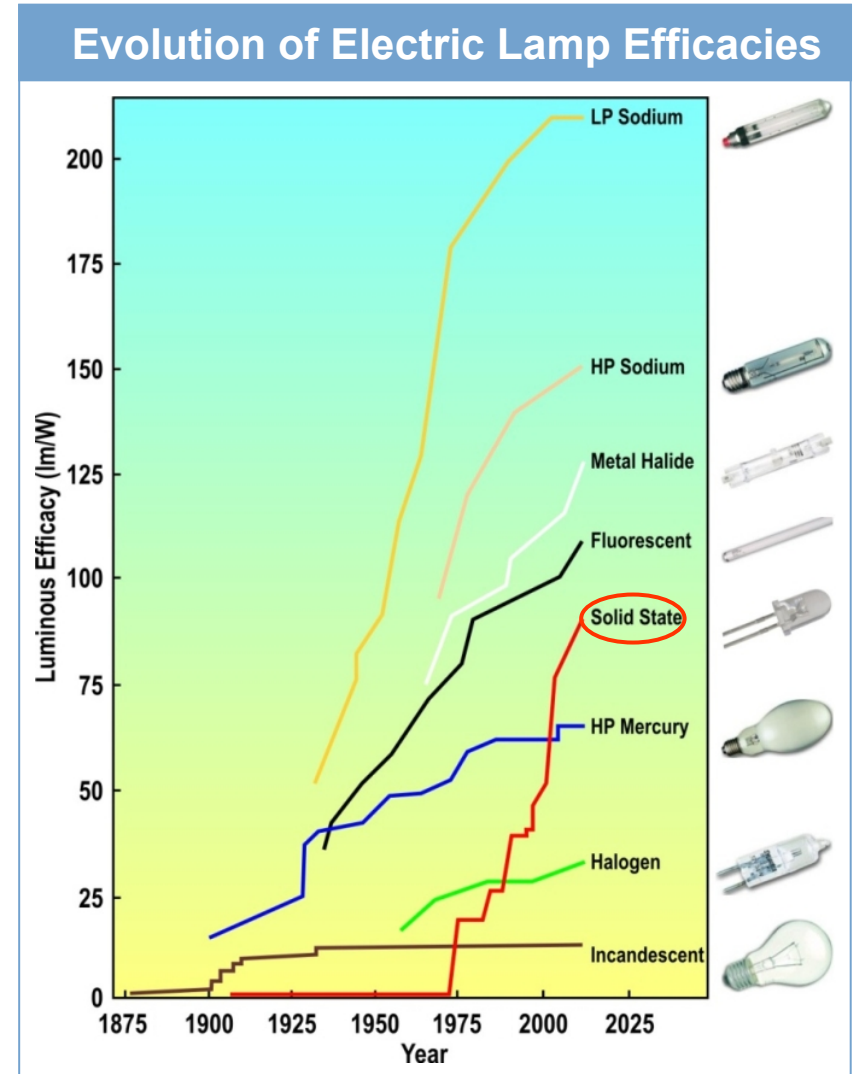
- LEDs can excel in lifetime and efficacy, but this is not always enough
- No single light source technology achieves leadership in every category
 - *That is why we still manufacture so many different types of lamps*
 - *There is always an optimum light source for each given application*
- Havells-Sylvania is eagerly contributing towards LED development, but specifies them only when they genuinely make the best all-round choice

Pro's and Con's for LED Retrofit Lamps

	LED-i	CFL-i	GLS / Halogen
Lamp Efficacy	20-50 lm/W	40-80 lm/W	10 - 25 lm/W
Lifetime	5,000 - 50,000 hrs	5,000 - 20,000 hrs	1,000 - 5,000 hrs
Lumen Package	1 – 250 lm	100 – 2,000 lm	1 – 200,000 lm
Physical Size	Compact	Large	Average
Optical Control	Excellent	Poor	Average
Run-up Time	Instant	Slow	Instant
Color Rendering	Average	Good	Excellent
Dimmable	Sometimes	Sometimes	Yes
Retail Price / lumen	€0.125	€0.005	€0.001
Reliability	Poor	Good	Best

4. The Challenges of Standardising LEDs

- Conventional light sources enjoy commercial lifetimes of decades
 - Rate of progress is slow but steady
 - *Matches the slow speeds of standardising*
- LED sources are undergoing a remarkably rapid evolution
 - *Products often obsolete before standardising committees meet!*
- Consequence : we do not have adequate LED standards today



Why do we need Standards for LEDs?

- The market is flooded with LEDs claiming to replace conventional lamps and luminaires
- Many genuinely achieve this, but most fall far short
 - Example : *A product claiming to replace a 50W halogen may typically deliver less light than a 25W halogen!*
 - This is damaging the consumer perception of LED in general!
- Limited market surveillance to identify these cases, and lack of standards means they cannot easily act
- Conclusion : Consumer often suffers with weak performance
Negative impact on rate of LED penetration

Case Study : The 50W Halogen Retrofit

- Halogen lamps sold by a candela figure for a given beam angle
- Luminous flux is generally not published, for example:

Wattage	Beam	Candelas	Lumens
25 W	25 °	500 cd	125 lm
35 W	25 °	800 cd	200 lm
50 W	25 °	1200 cd	300 lm

- LED is an optically more efficient light source than halogen
- Can achieve similar peak intensities for far fewer lumens!

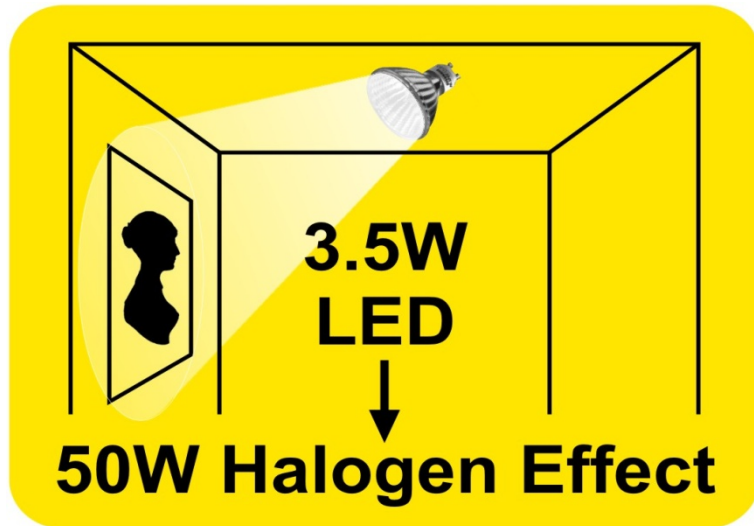
LED 3.5W	20 °	1200 cd	150 lm
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- Can this lamp really be considered as a 50W halogen retrofit?
- The answer is yes, but maybe not in all applications.

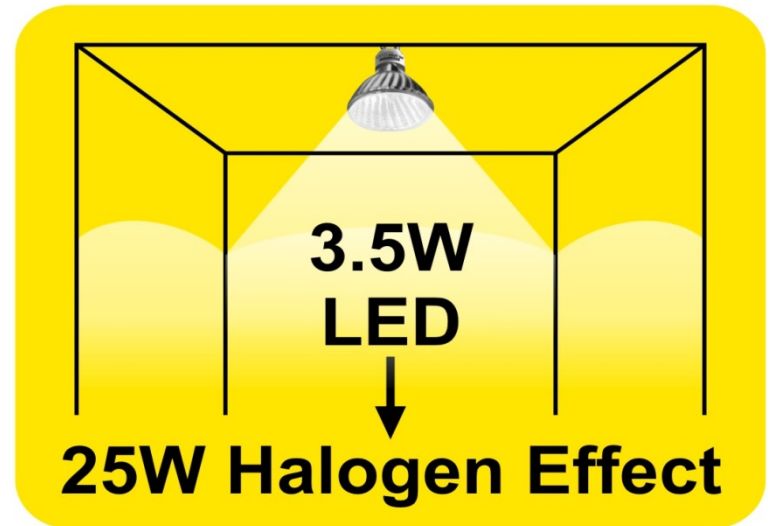


EcoLED ES50 3.5W – Application Guidelines

Equivalency Guide for Accent / Spotlighting



Equivalency Guide for General / Downlighting

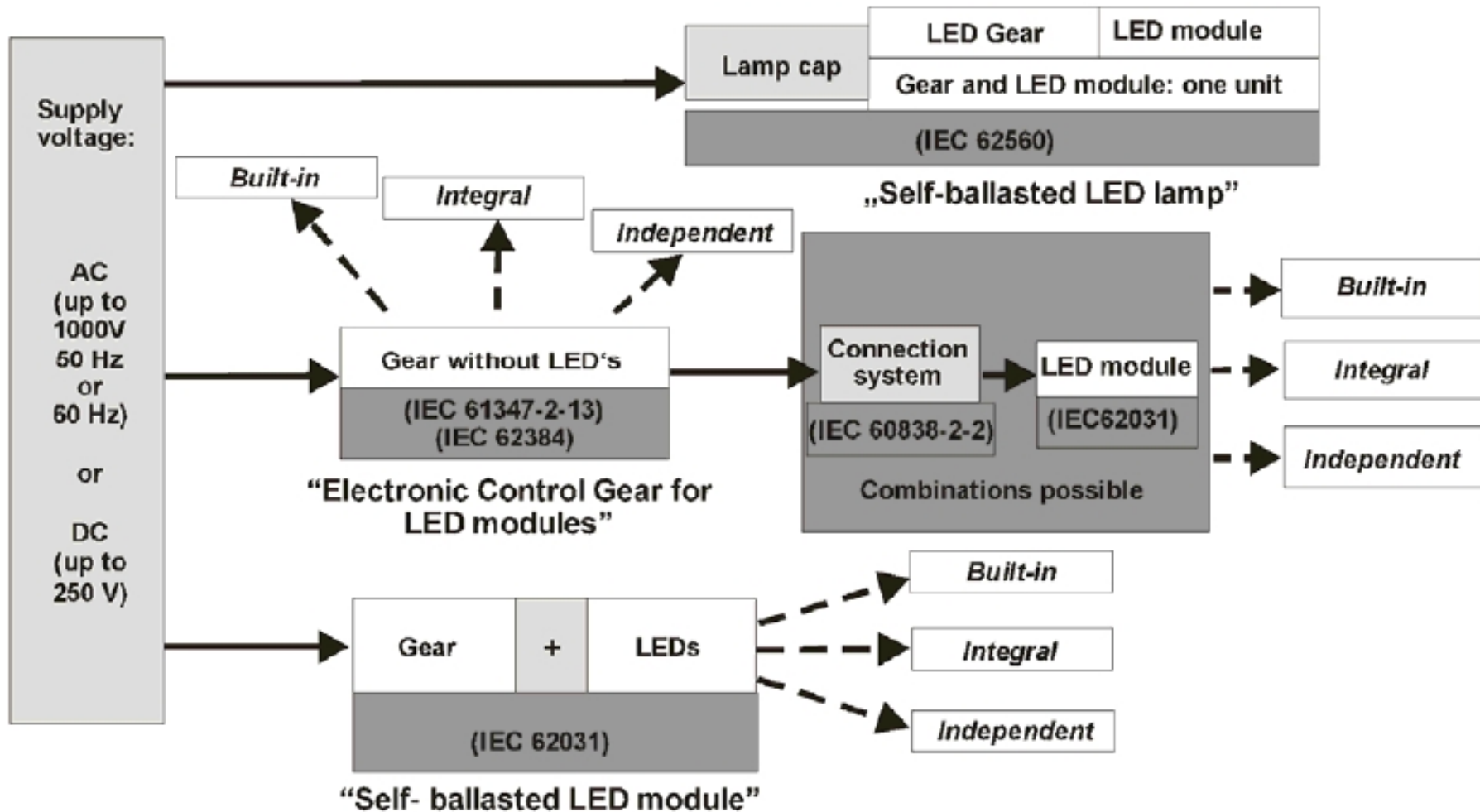


- For General / Downlighting, Luminous Flux (lm) must be equal to halogen lamps. Here we can achieve the performance of 25W Halogen GU10.
- For Accent / Display lighting, Luminous Intensity (cd) must equal halogen lamps. Here we can match the performance of 35W Halogen GU10, with less spill light.
- Crucial point to standardise to avoid customer dissatisfaction in general lighting!

Standardising in Europe

- ELC has developed a comprehensive list of how many lumens an LED must deliver to claim equivalence to a conventional lamp
- New term of “Lumens in a 90 degree cone” defined to cover reflector light sources.
- Various other minimum performance targets being set to join the existing IEC Safety Standards, e.g.
 - Minimum lamp lifetimes*
 - Maximum lumen depreciation*
 - Minimum colour rendering quality*
 - Minimum number of switchings*
 - Minimum power factor*
 - Maximum early failure rate*
 - Definitions, including “Halogen Retrofit”*

Current Status of IEC Standards for LED



5. Havells-Sylvania LED Introductions

- Havells will shortly launch full range of Sylvania Lamps & Fixtures in India
- In LED Lamps we offer a fully comprehensive family of retrofit products
- In-house designs offer best-in-class performance throughout range
- Luminous efficacy up to double that of generic LED retrofits
- Tried & tested in Europe and proven to deliver exceptional reliability
- Full range of Directional, Non-Directional & Decorative LED lamps
- Imminent availability of “2nd Generation” lamps with matching luminaires



Havells-Sylvania LED Luminaires

- Broad range of professional quality fixtures
- Backed by leading brands Concord & Lumiance
- Best-in-class product performance
 - Exceptional design detail + highest efficacy
 - 2010 winner of Lighting Design Awards, UK
- Highly innovative designs, both technically and aesthetically
- Specifically tailored for optimum results in one of six application areas:



Sylvania Fixture Lighting Markets

Retail & Display



Commercial



Hotels & Leisure



Residential



Industrial



Outdoor



Sylvania General Lamp Markets

LED



Halogen



Incandescent



Compact Fluorescent



Linear Fluorescent



High Intensity Discharge



Sylvania Special Lamps Markets

Photo Optic

BriteArc

DASH TWO: IT'S BRIGHT AND CRISP

- High colour temperature with 8,500K or 7,500K for higher perceived brightness
- No colour differences between 50702 SE 0.8 and 57072 SE 0.5 allowing maintenance free, consistent colour problems.
- Excellent colour temperature stability over life so new and old lamps can be used together
- Plugged construction allowing use in any location, suitable for moving hands
- Interchangeable, all 22 pin sockets are identical and universally interchangeable with 12 pin BriteArc DC 1000 products

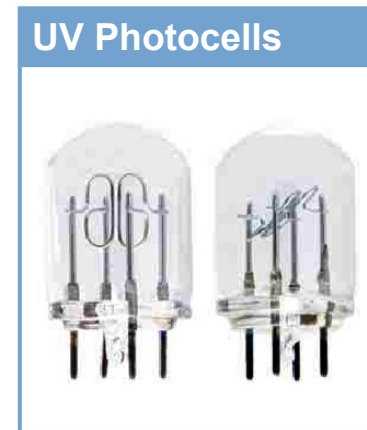
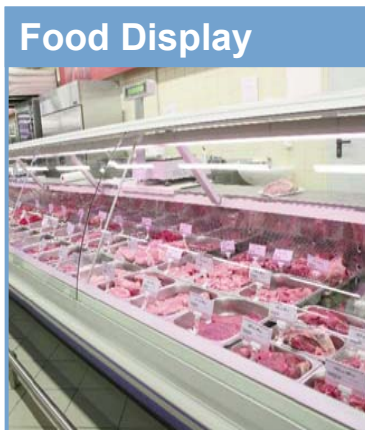
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Personal Care

THE NEW BRONZE AGE

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Any Questions?

