

Rapid Progress in High-Brightness LEDs for Projection

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LED Projection Progress

- ➔ • **Here and now** - LED light sources for projection TV
 - **PhlatLight™** - the technology behind the projection LED revolution
 - **Reliability** - key for lamp to LED conversion
 - **Roadmap** - more LED brightness and more projection products

Summer 2006: LED based DLP TV emerge

- Samsung and NuVision launch **first** LED based DLP TVs
- Numerous awards and accolades



Spring 2007: LED illuminated DLP TV is now hitting prime time

- Samsung launched **six (6)** all-new LED based DLP TV models
- Now in all major retail chains
- Slim depth
- Thin bezel
- DLP® xHD5 for price competitiveness
- ~130% NTSC
- Active color management (major improvements)
- Cinema Smooth

50" 56" 61"

50" 56" 61"

Sears

circuit city

BEST BUY

amazon.com.

CRUTCHFIELD ELECTRONICS .com

SAMSUNG

Tweeter

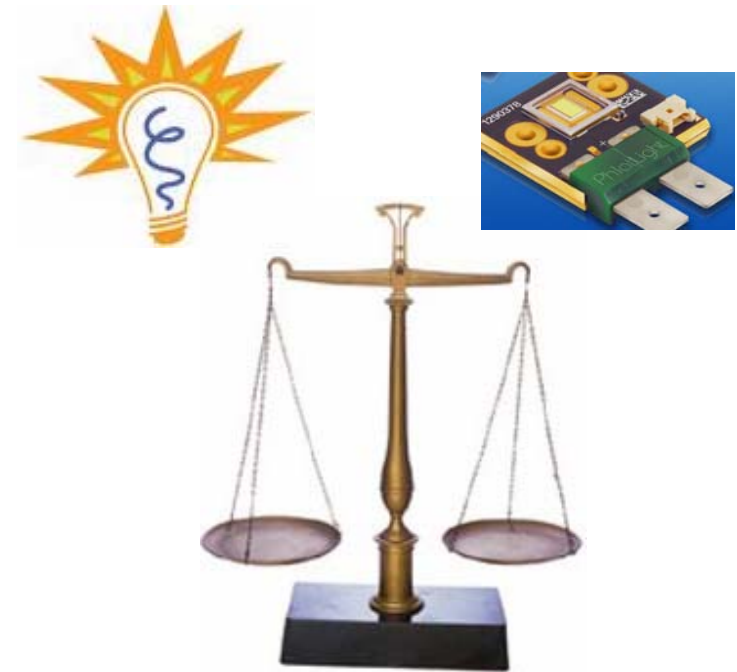
SAMSUNG

HL-T6187S
HL-T5687S
HL-T5087S

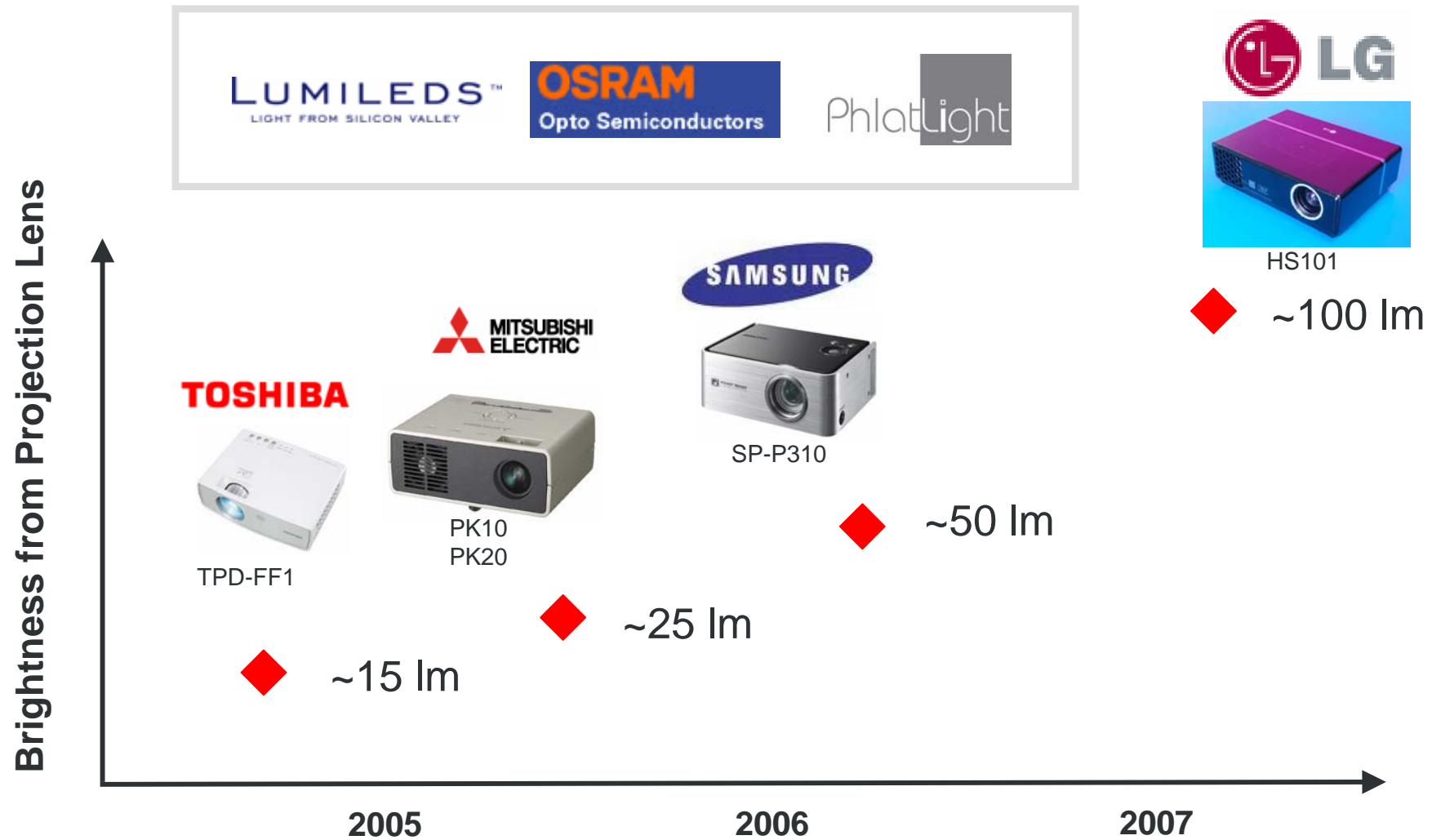
HL-T6189S
HL-T5689S
HL-T5089S

Microdisplay Projection TV is at a **tipping point** toward all-LED illumination.

- The story of arc lamps vs. LEDs
 - Lifetime
 - Color
 - Contrast and brightness
 - Instant on
 - Environmental footprint: a recurring theme
- The dynamic of tipping: it's all or nothing
 - Its happening now
- The technology behind it: **PhlatLight™** from Luminus Devices
 - the only LED that can presently do it



LG launches first 100 lm LED pocket projector - enabled by PhlatLight



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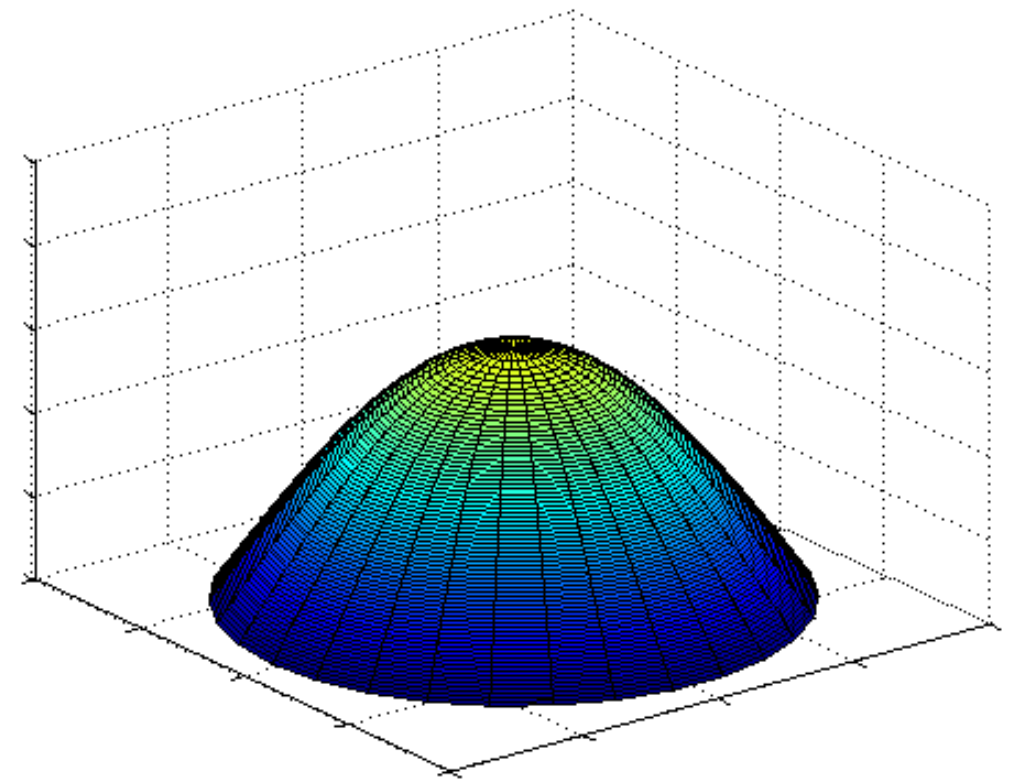
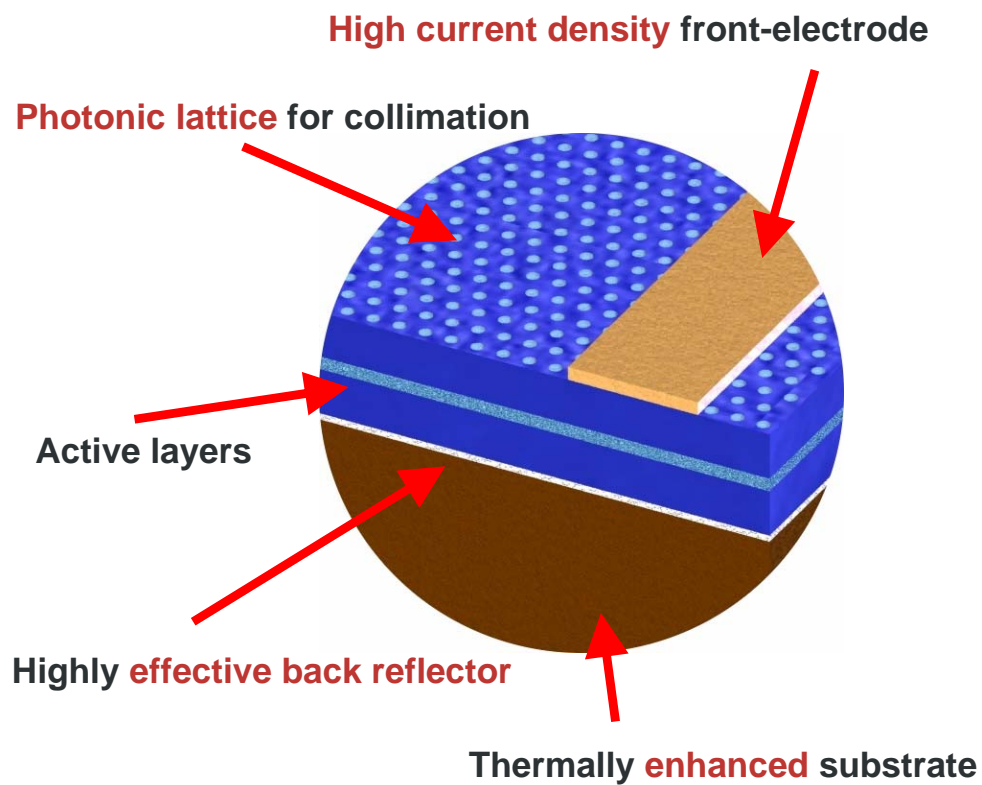
PhlatLight™ technology from Luminus Devices: a breakthrough in Solid State Lighting.

- PhlatLight™ = Photonic Lattice Light Emitting Diodes
- What is it, why do we need it?
 - An intricate microstructure embedded in the LED
 - Efficient, uniform, collimated light extraction from the chip surface
 - The product: incredibly bright large-area devices



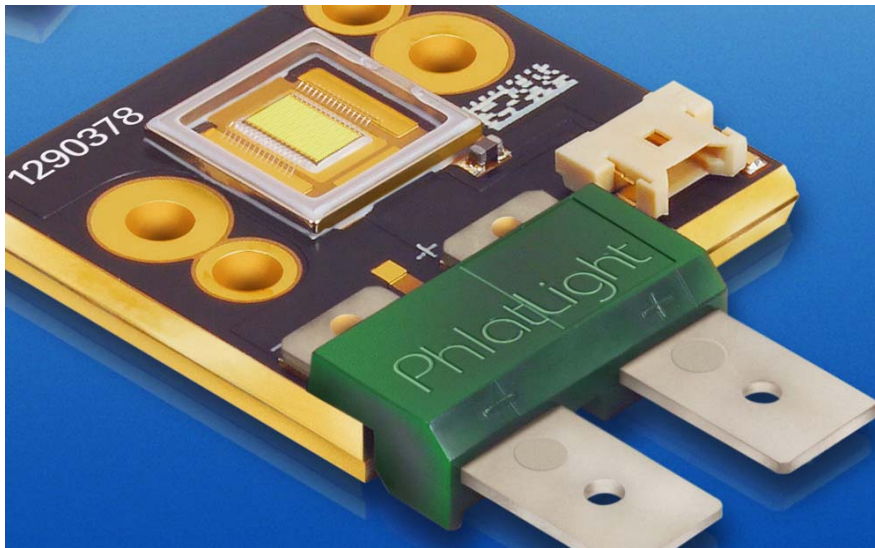
PhlatLight™: 100% collimated surface emission

Lambertian Radiation Pattern



The engine behind PhlatLight™ projection TVs

Luminus flagship product: PhlatLight Projection Chipset PT120



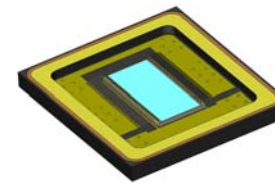
For example: **GREEN**

- **Monolithic single chip** with 12 mm² emitting area, 16:9 aspect ratio
- Uniform emission, no gaps in emission area
- 18 A forward current continuous
- 30 A pulsed current for DLP
- Up to 90 W electrical power in single chip
- **>3000 peak lumens** at 30A
- Highly efficient: **>25 lm/W at 1.5A/mm²**
- 100% **collimated surface emission**
- Designed for air-cooled heat sinks

PhlatLight is more than just a photonic lattice: it is a suite of innovations at the **chip and package** level.

- A scalable large area, rectangular chip technology
- Breakthrough electrical and thermal “vertical” chip design
- Unprecedented reliability under extreme operating conditions
- Ultra-high performance, customizable packaging platform

PhlatLight™ enables single, large-area chip instead of multi-LED arrays.



LED Projection Progress

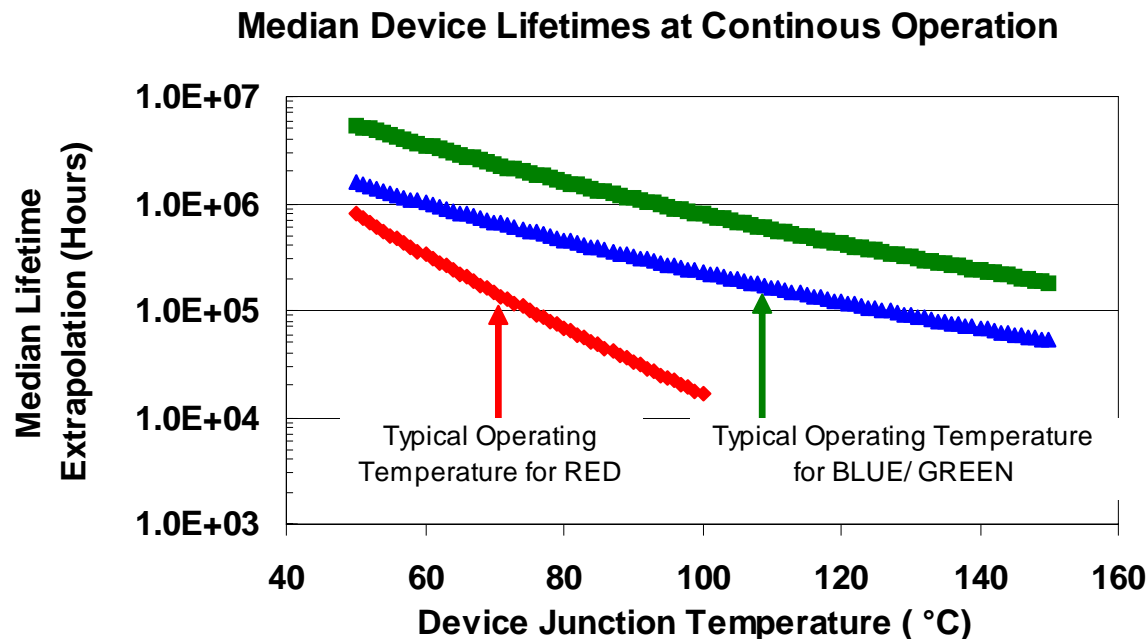
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PhlatLight™ is the most reliable projection light source available

- PhlatLight LED technology is inherently reliable
 - High current density design, low thermal resistance
 - Photonic lattice extracts light into air, no encapsulant which can fail
- **Fully qualified** in several product launches
 - Luminus and customer qualification programs
 - Full suite of mechanical and environmental tests
 - Mechanical and thermal shock, vibration, humidity, ...
- **> 1,000,000 hrs** actual device hours lifetime testing
 - Continuous current and pulsed
 - Most under accelerated conditions
- Qualified for high power and current operation
 - An LED industry first: 2.5 A/mm²

Long lifetime ...

- PhlatLight™ chipsets have median lifetimes **above 100,000** hours at TV operating conditions

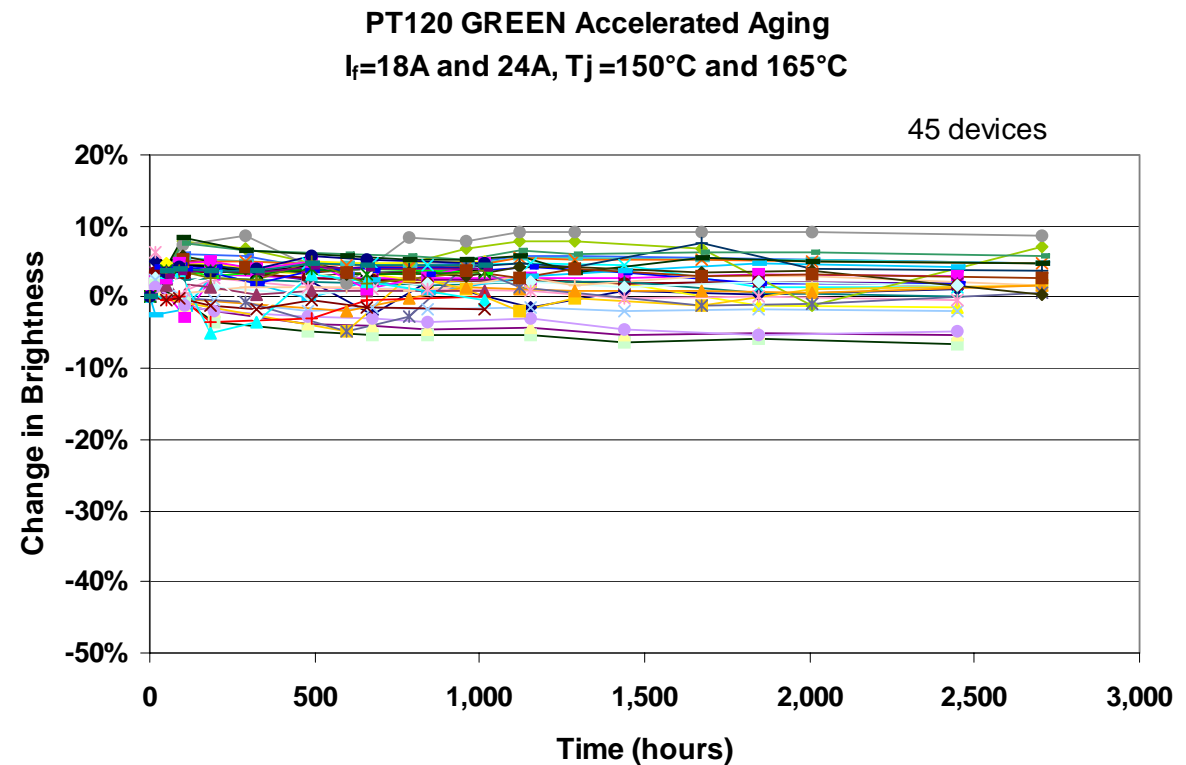


- No perceivable brightness degradation during typical TV lifetimes

Finally, the light source lives longer than the TV

... and high reliability

- Very tight distributions of brightness degradation
- Very low random failure rate
- Supported by sophisticated quality control system and state-of-the-art reliability facility



Therefore, an LED industry first:

Luminus introduces a **warranty for PhlatLight™** chipsets in qualified TVs:
 24 months

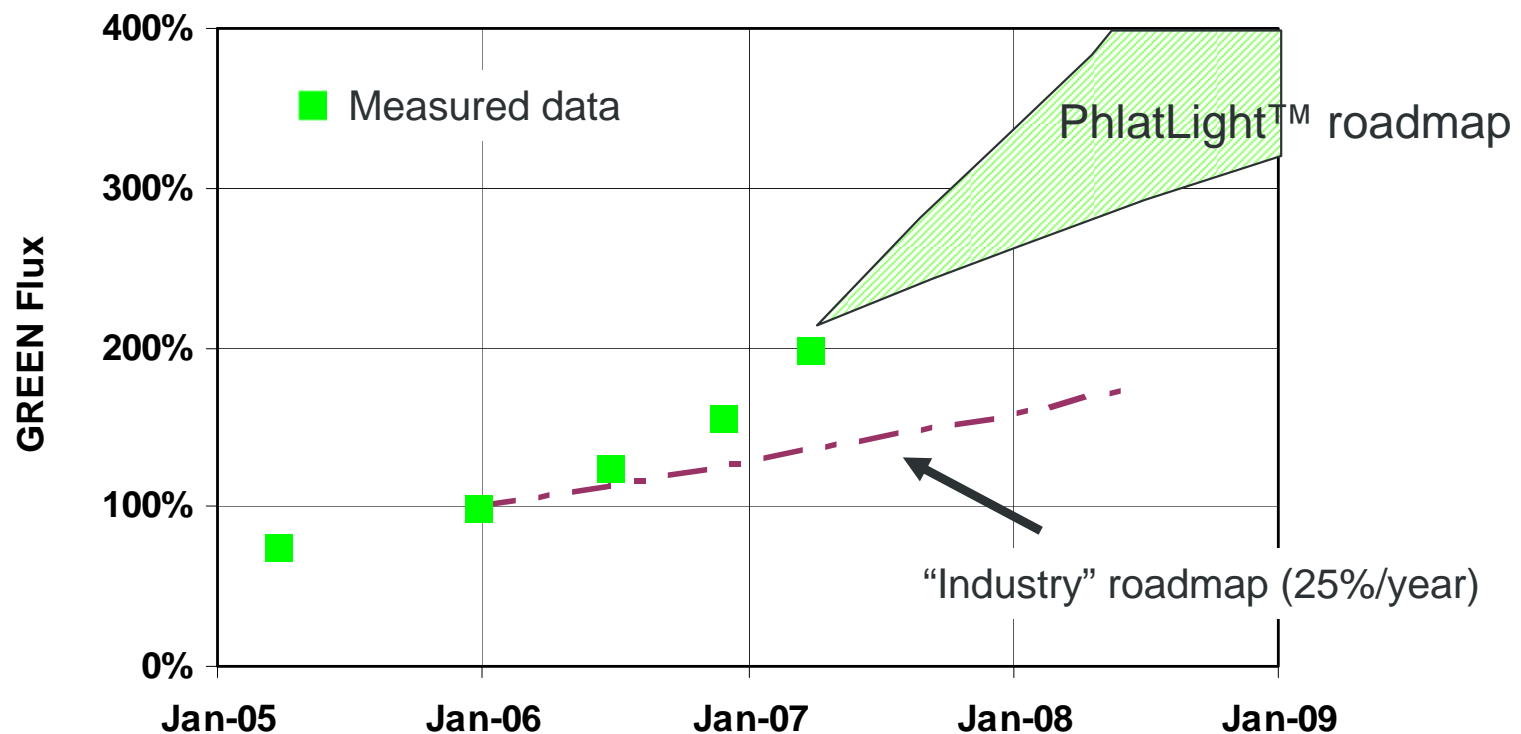
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LED Brightness will continue to increase

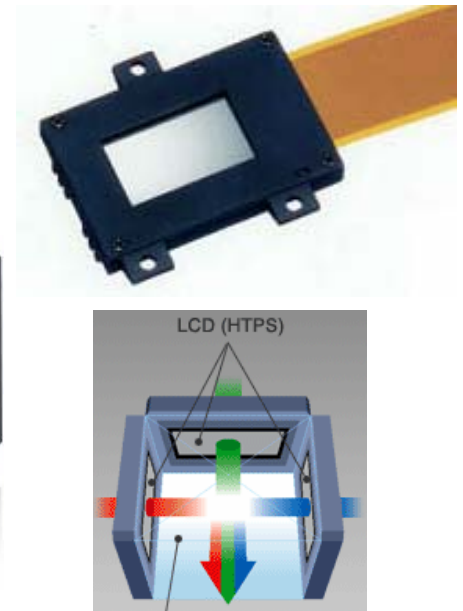
- PhlatLight™ brightness has already **doubled** since first TV launch in Jan 2006
- Performance improvements will continue at **rapid pace**



What products are next?

Significantly higher performance LED chipsets will enable

- **Full conversion** of DLP TV to LED
- Other microdisplays (LCoS, HTPS)
- Larger screen sizes: >65" and larger
- Pocket projectors with 150-200 lm
- Home theater projectors with **500+ lm**
- Increasing brightness can be used for multitude of further product improvements: screen gain, contrast ratio, power consumption, cost



Summary

- LEDs elevate color and image quality of Projection TVs to a new level
- LEDs are the longest lifetime light source available for projection
- LEDs for projection are supported by a **mature**, multi-billion dollar **industry** (Osram, LumiLeds, Cree, Nichia, Epistar, ...)
- In 2008, LED projection TVs will be the norm, **full transition** from arc lamps will conclude end of 2008
 - Will make market entry for other light sources very difficult
 - LEDs and arc-lamps will be the default light sources for projection
- LED brightness will continue to increase at rapid pace
- PhlatLight™ technology will continue to push the limits

→ LEDs present a great opportunity for Projection TV

Thank you

- To our **customers** - who believe that LEDs are the future of projecton illumination and make great products happen
- To the **Luminus team** - which invested their creativity and skills into the future of LED illumination, and makes Luminus a great place to work
- To our **investors** - who put their money into the technology to stay