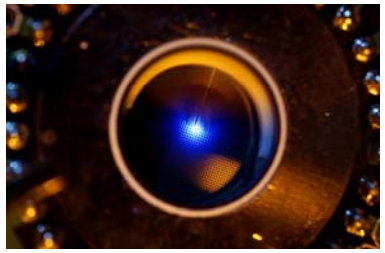
# LED Technology
## for Streetlighting

**Dieter Soukup**
**Regional Sales Manager Europe & EEM**
**d.soukup@osram.com**

Opto Semiconductors OSRAM

# OSRAM Opto Semiconductors at a glance



**Overview**

OSRAM Opto Semiconductors GmbH

Established: 1999 (former Part of Siemens Halbleiter)

Turnover: **USD 800 million** (30.09.2008)

Employees: 4.600 worldwide

Latest Awards:

2007 German Future Prize for technology and innovation

2007 Best Innovator (Wirtschaftswoche, AT Kearney)

2006 PACE Award (Automotive News, SAP, Microsoft et al)

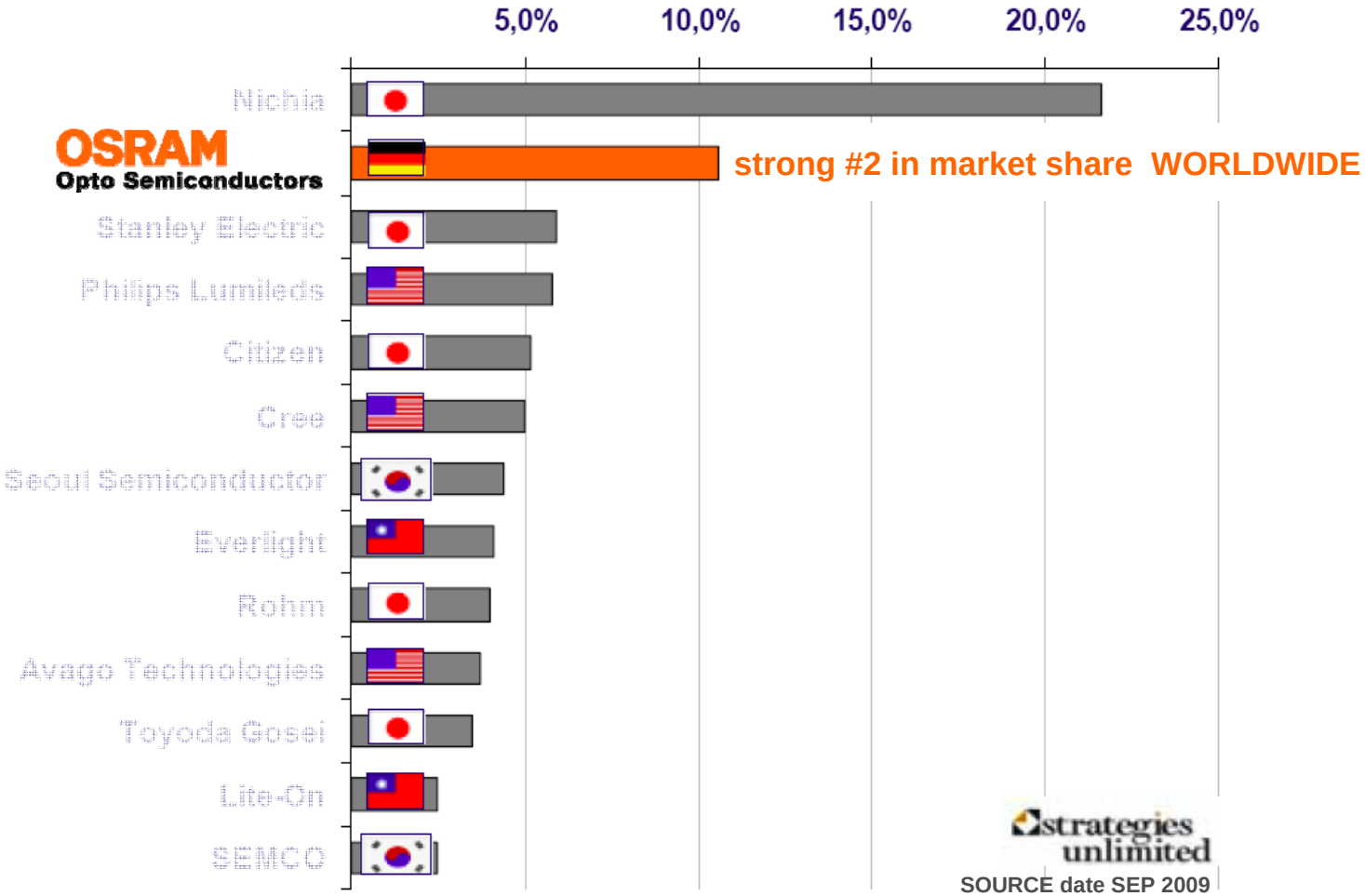
Operating the worldwide 2 most modern LED manufacturing sites

Yearly Investment of up to USD 120 million in research and development

Owning over 4.000 patents worldwide

# Market Share
# High Brightness LEDs ( Source: Strategies Unlimited – SEP 2009 )

## OSRAM OS is Market Leader in Europe and a strong #2 worldwide



# Worldwide leading companies trust in OSRAM OS

ZUMTOBEL

SONY

Audi

iGuzzini

FIAT

SAMSUNG

PHILIPS

NOKIA
Connecting People

htc

PEUGEOT

BMW

Panasonic
ideas for life

LG

LANCIA

## Local company

LEDEL

ŠKODA AUTO




# LED Technology
# Our Quality Strategy

## Zero Tolerance To Defects - ZTTD

**Vision**

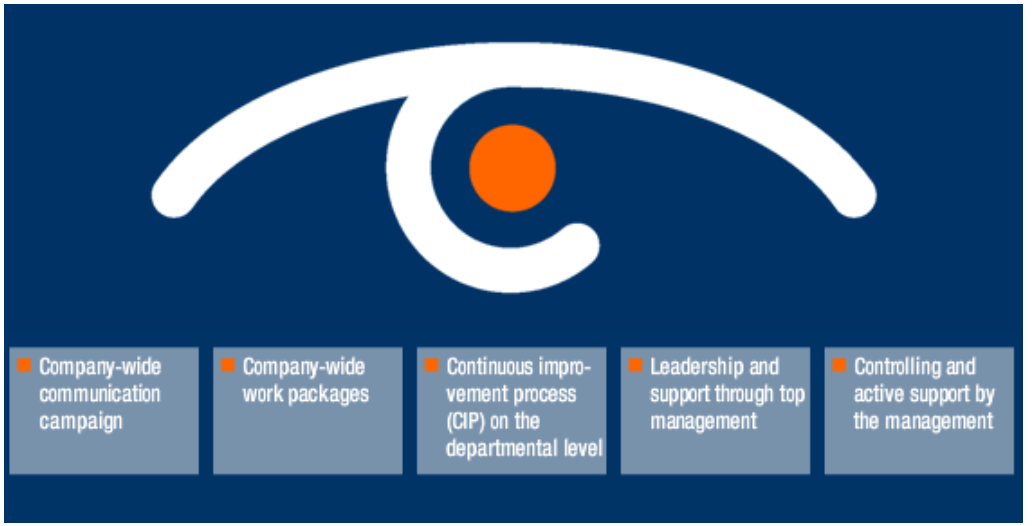
*"OSRAM OS produces outstanding quality that exceeds our customers' expectations and increases the success of the company."*

**Mission**

*"Quality is a factor in success and a distinguishing feature in the market. It is our job to focus thought and action throughout the company more acutely in order to achieve sustained success in this dynamic market environment."*

**OSRAM OS has one of the highest quality levels in the Semiconductor Industry.**

**Our Quality Level is in the range of about 1-5ppm**



# LED Technology
# Performance and Quality Features

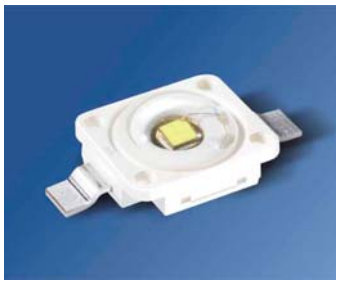
- **Highest Chip Efficiency**
- **Phosphor: Conversion Efficiency**
- **High Performance Thermal Management**
  Complete Power Consumption vs. Light Output
  must be considered for lm/W calculation on LED level

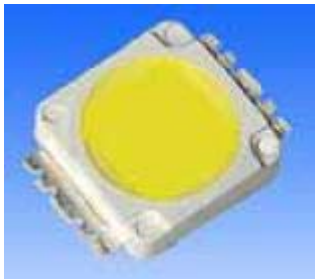
- **Phosphor: Color Stability over Lifetime**
  Quality of Light

- **Package Quality**
  Temperature Cycles stability

- **Lifetime Durability of all parameters**

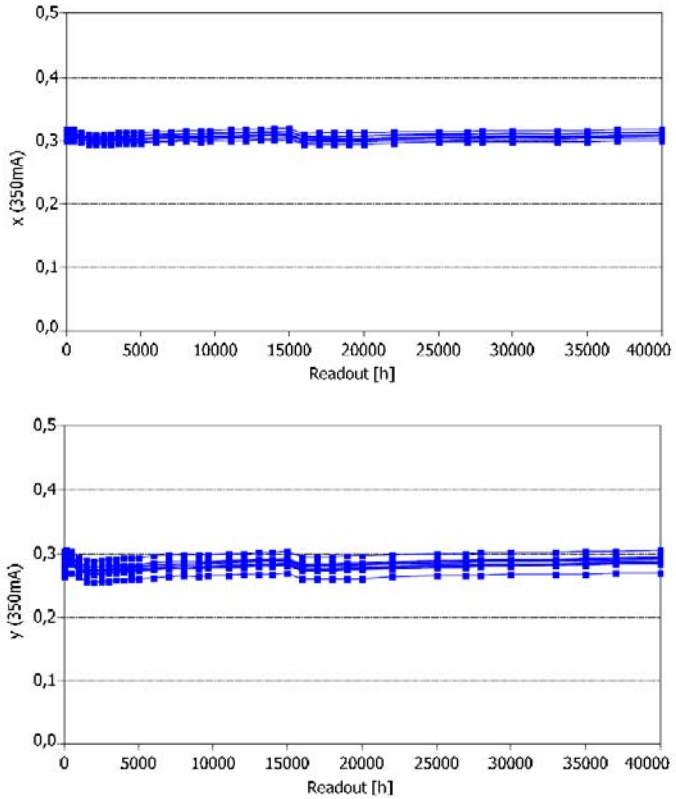
**COMPARISON**
**OSRAM OS** **vs.** **Competitor**





# LED Technology
# Phosphor stability

## REAL OPERATION LIFETIME TEST – No Simulation

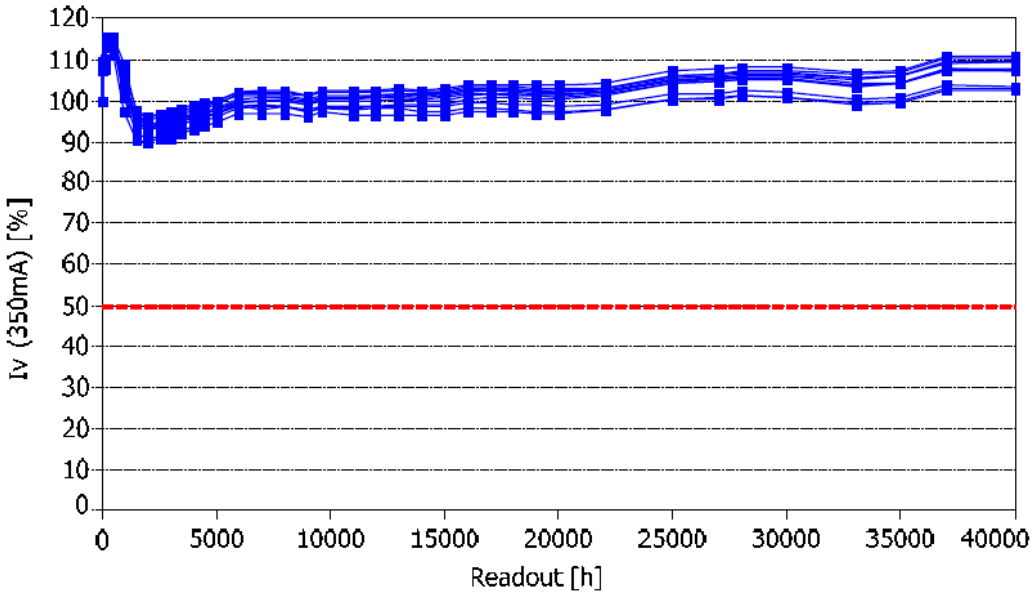



- Test of OSRAM OS LW W5SG samples
- Steady state lifetime test at $T_S$=85°C and 350mA about **Tj = 98°C**
- Excellent stability for over 40000 h already

- Stability of color coordinates is as important as brightness

# LED Technology
# Lifetime and reliability

## REAL OPERATION LIFETIME TEST – No Simulation

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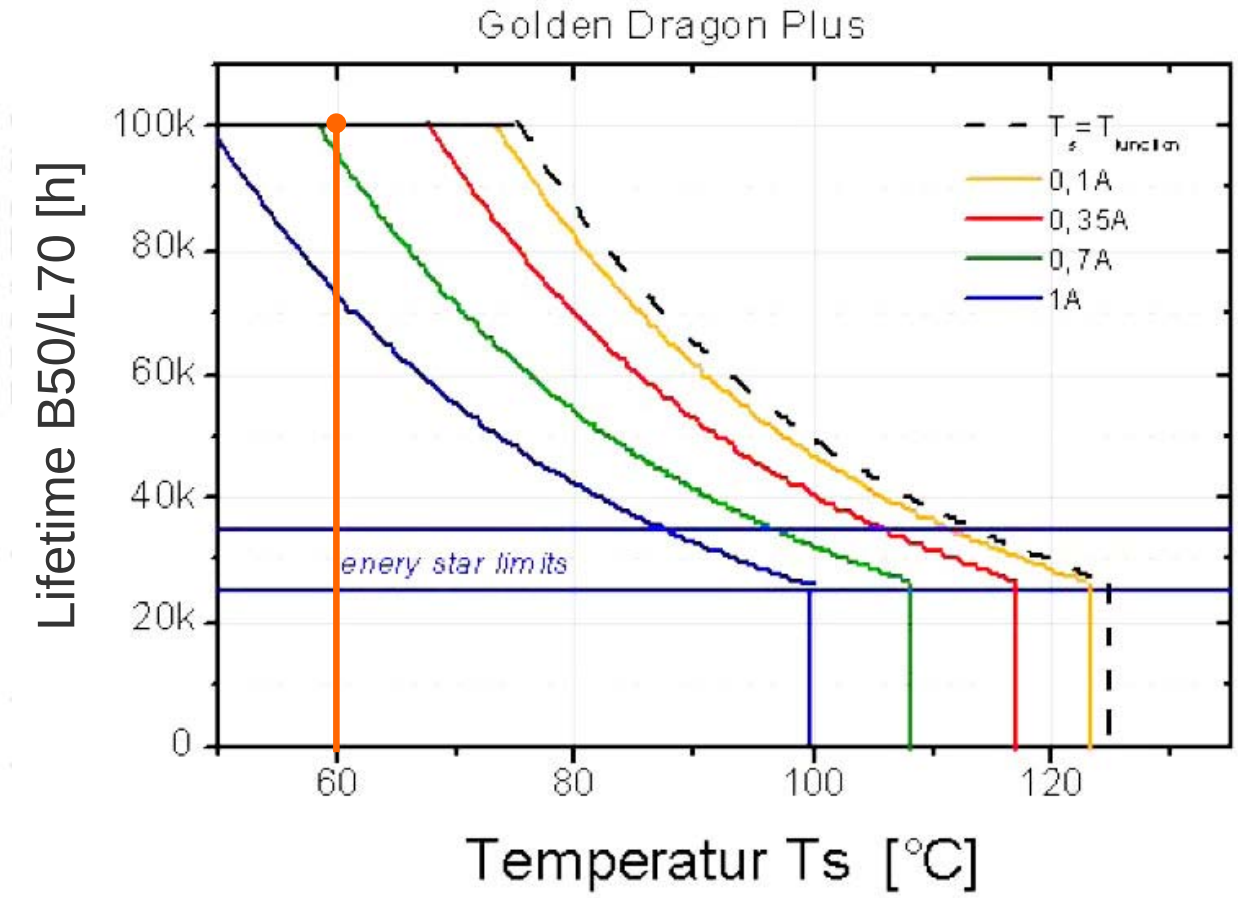
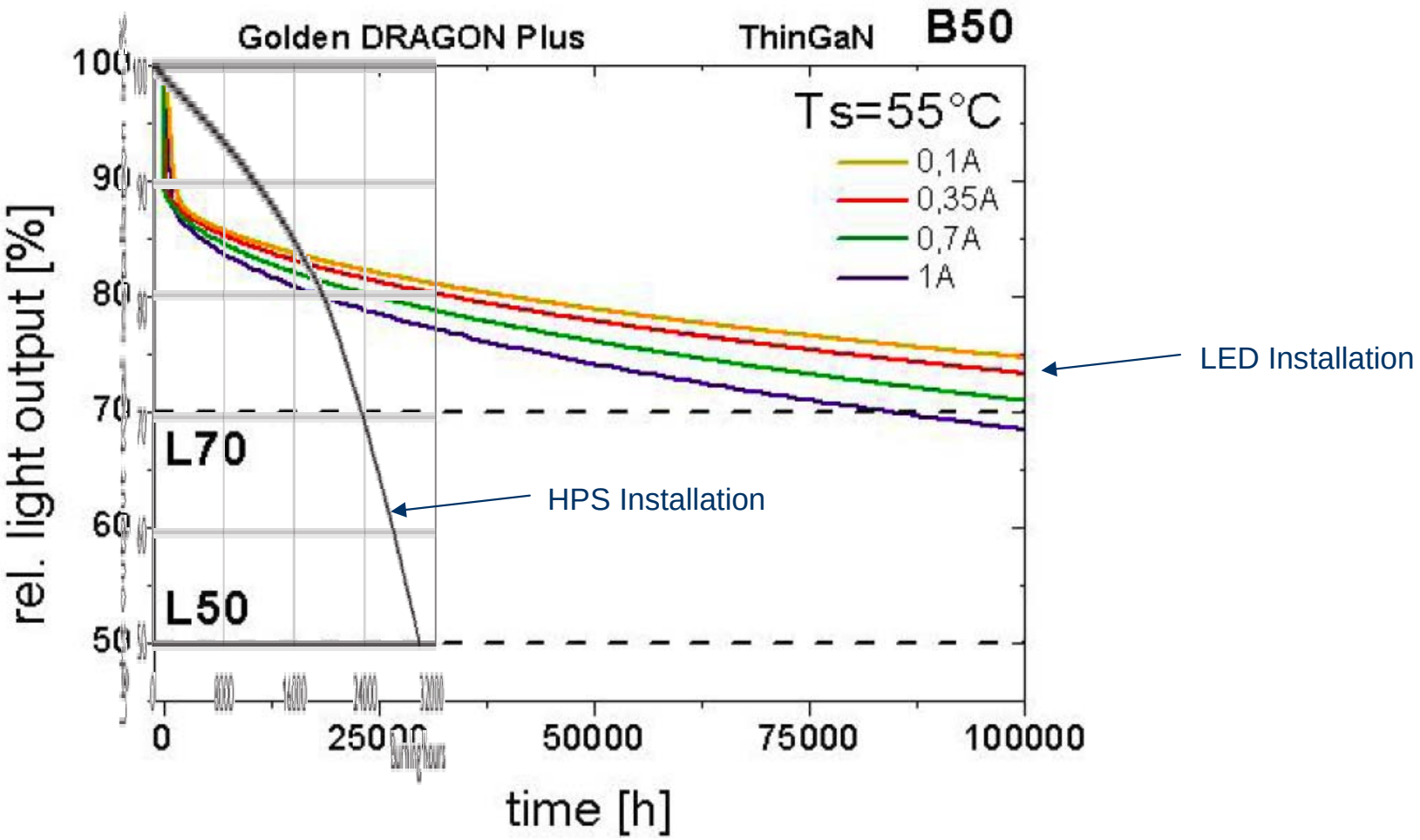
# LED Technology
# Lifetime Chart B50/L70



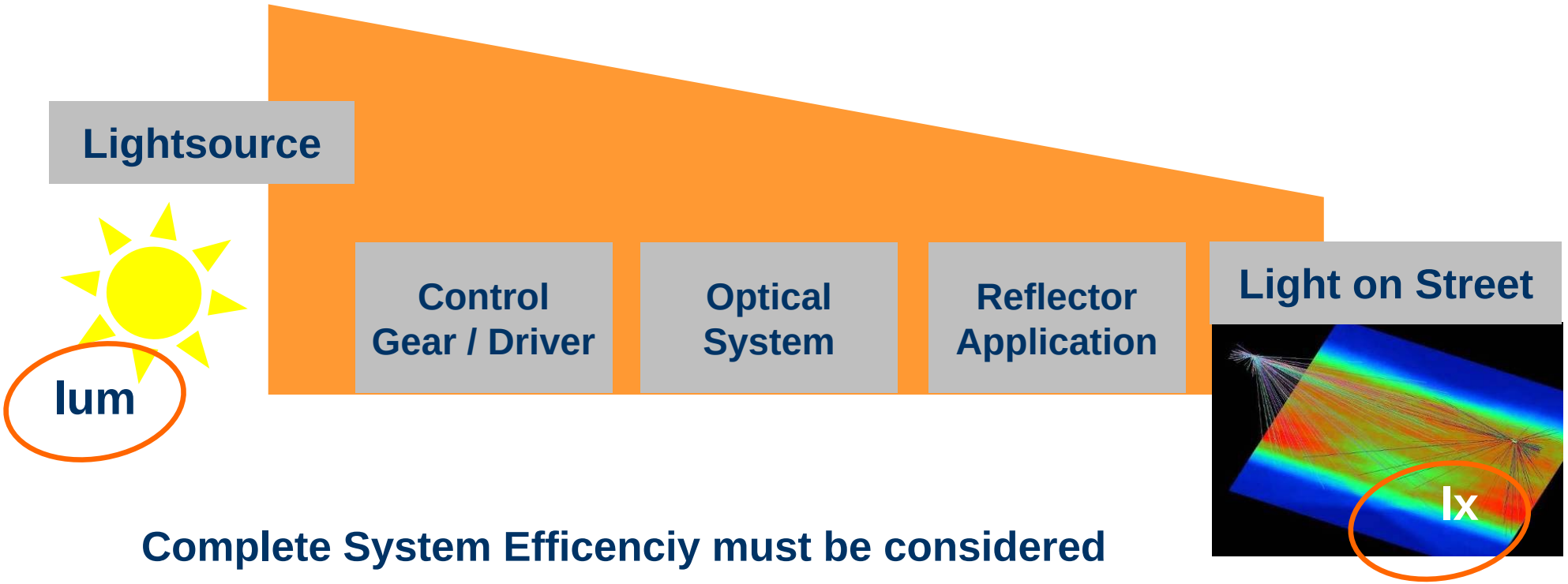

**Application Note:**
**Reliability of Dragon family**

Adobe Acrobat 7.0
Document

# LED Technology
# Lightoutput Developement of Installation



# LED vs. HPS
# Complete lamp system application efficency



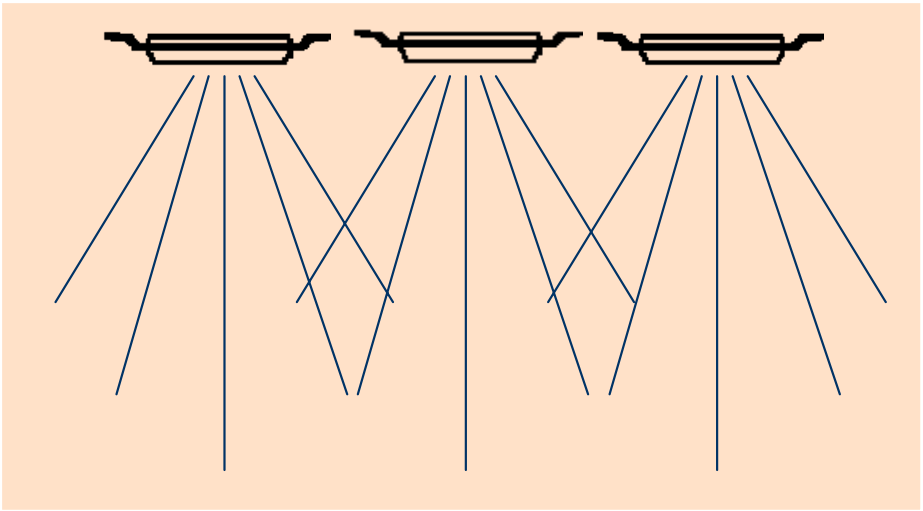

**Complete System Efficenciy must be considered**

**For calculations and any kind of comparison**

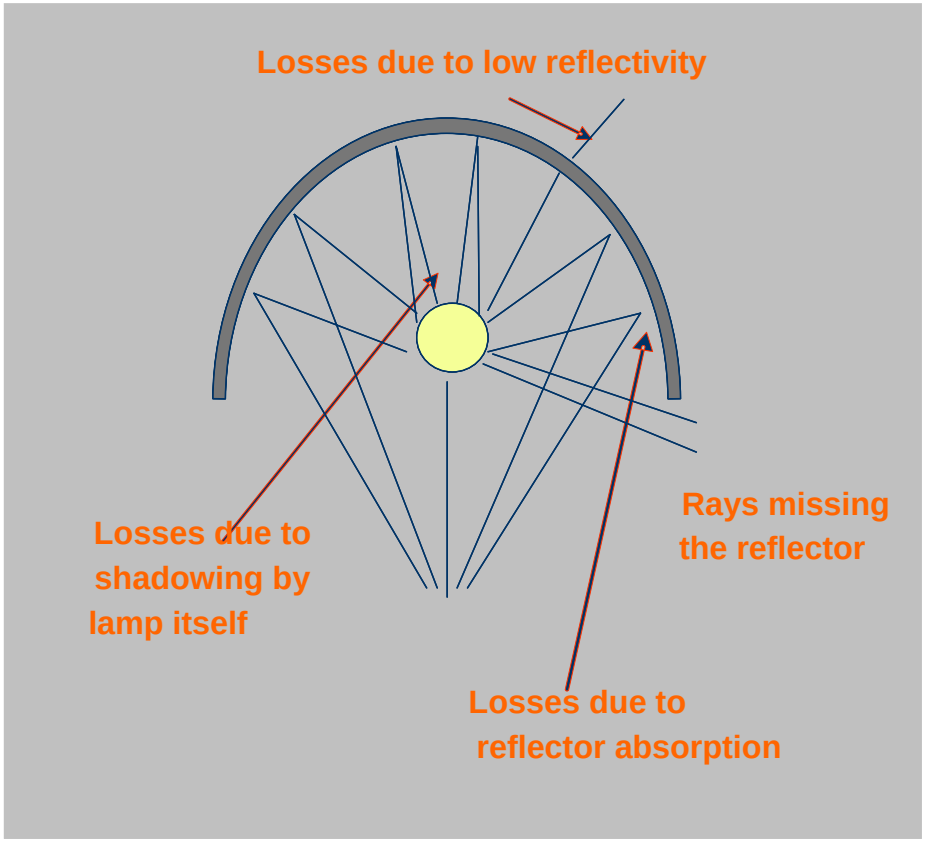
# LED vs. HPS
# Optical efficiency

## Direct radiation of LED fixtures more light to the street than conventional luminaires

### LED Systems



### Conventional lamp systems

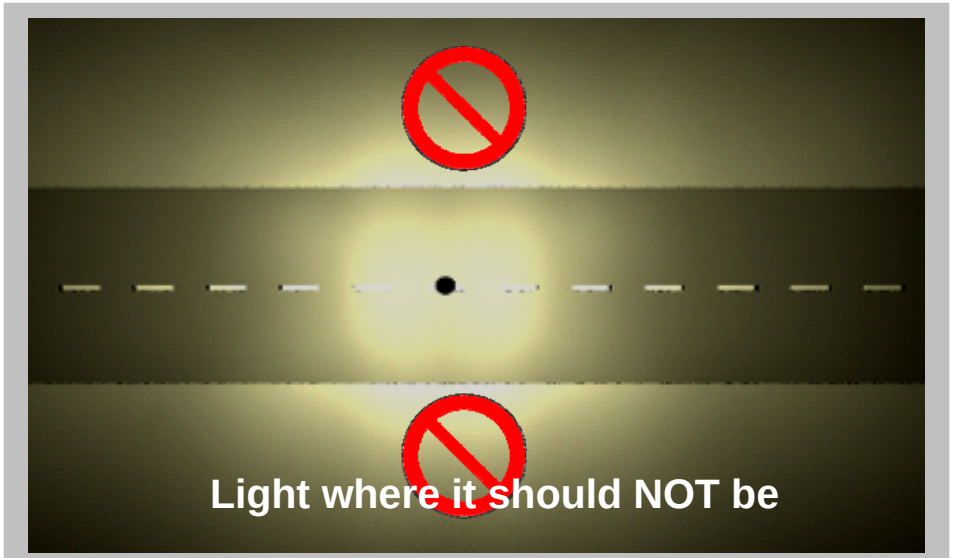



**Light where it should be!**

# LED vs. HPS
# LED = Light where it should be!

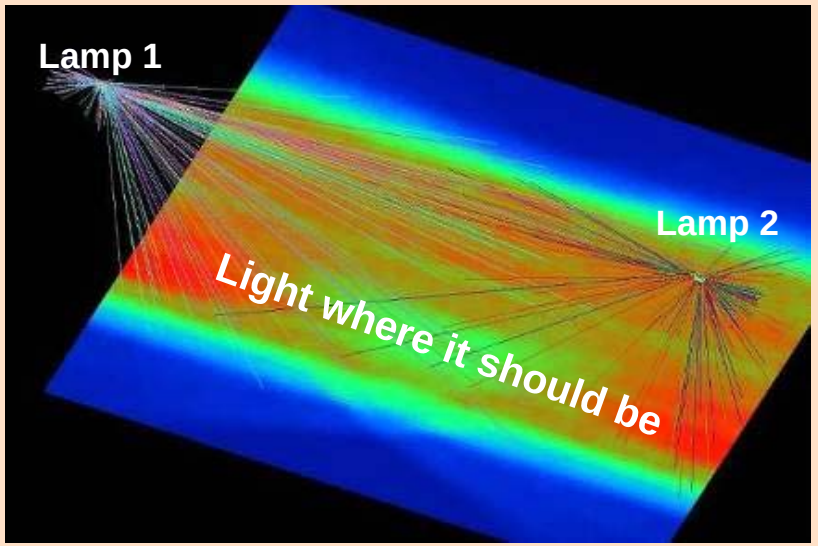
## LEDs need less lumens to reach the brightness target: lower energy consumption and environmental protection by better directionability

### Conventional system




- 30% of light is wasted
- Light pollution disturbing residents

### LEDEL LED System

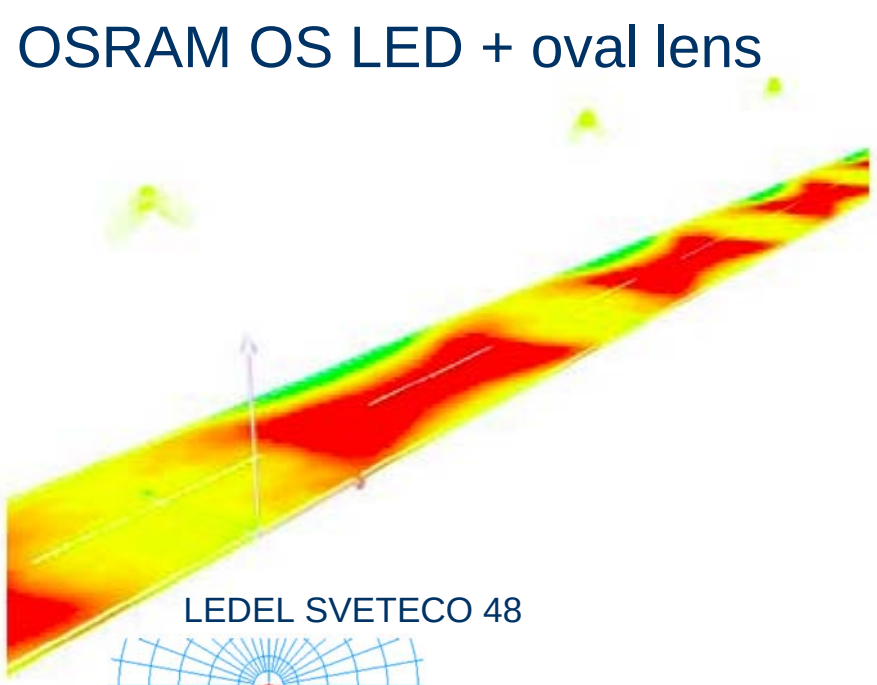


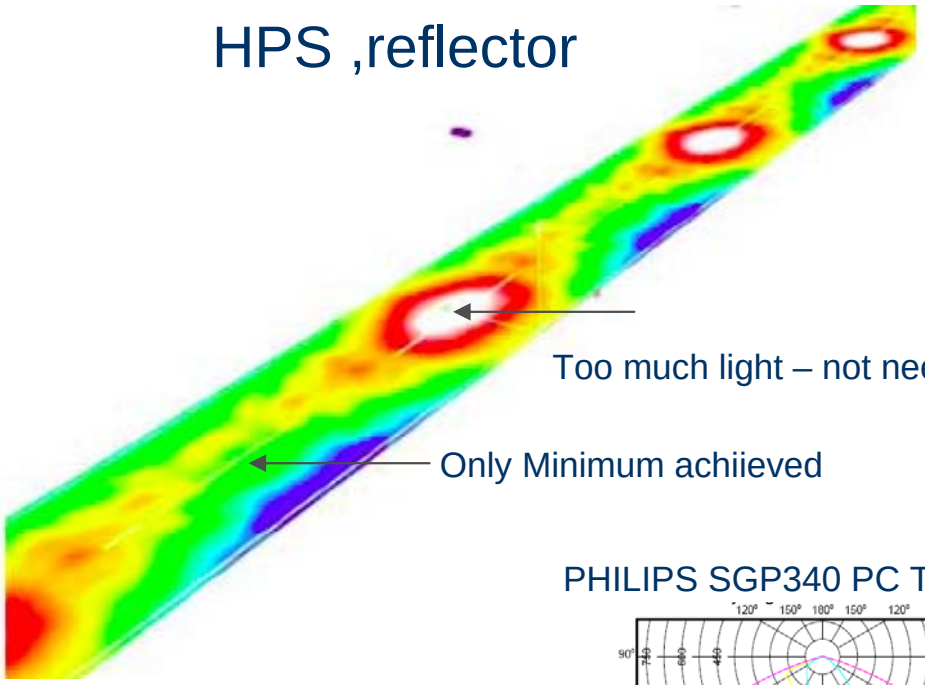

- perfect use of the lumen packages → high application efficienca
- Homogeneous light distribution → increased safety, less fatigue for drivers
- Birds and mammals can live undisturbed

# LED vs. HPS
# Homogeneous Illumination

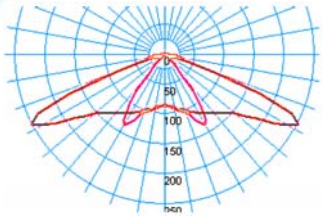
OSRAM OS LED + oval lens

HPS ,reflector



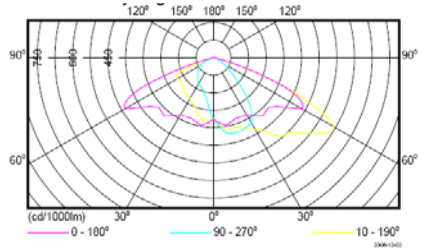



LEDEL SVETECO 48



SAME POLE HEIGHT AND DISTANCES

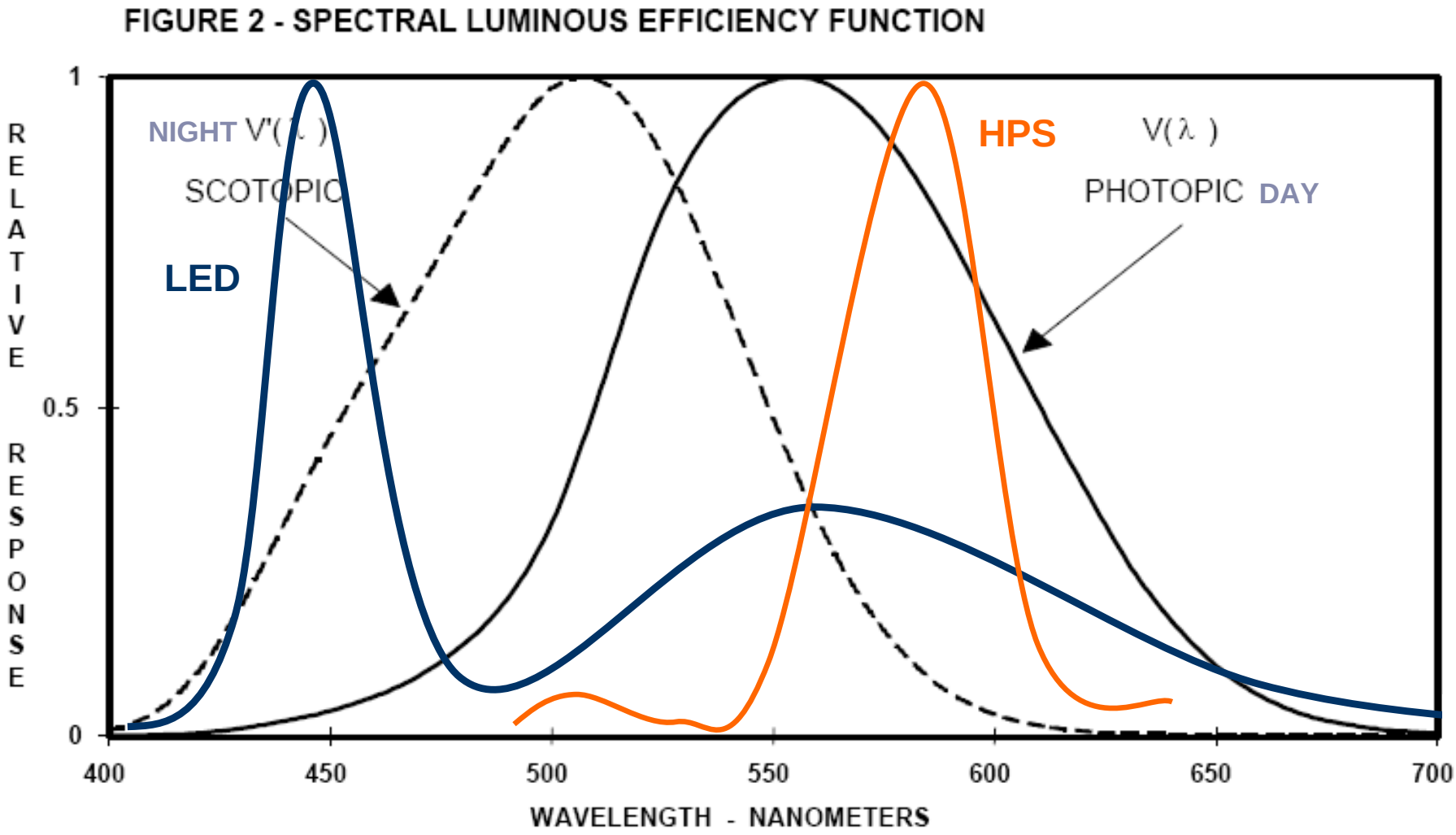

PHILIPS SGP340 PC TP P5



- **LED Lighting is providing a much higher homogeneous light distribution**
- **No energy for too much light is wasted – to reach minium level**

# LED vs. HPS
# Mesopic Factor

## The human eye



# LED vs. HPS
# Safety and Color Rendering

## Tomsk City

BEFORE with HPS

**with LEDEL Sveteco**

# Compare of LED and HPS in street lighting

| Light sources | LED OSRAM GD+ | FL | HPS SON-T PP 100W |
|---|---|---|---|
| Efficiency of light sources lm/W | 100 | 75 | ✓ 107 |
| Power selection possible | 25 - 160W | 20-50W | 100W, 250W, 400W |
| Power efficiency - Control Gear / Driver | 92% | 80% | ✘ 80% |
| Optical luminaire efficency | 90% | 70% | ✘ 83% |
| Thermal factor | 0,9 * | 1 | ✓ 1 |
| **System output efficiency lm/W** | **75 lm/W** | **42 lm/W** | **71 lm/W** |
| Reflector Application factor | 95% | 60% | ✘ 70% |
| Efficiency lm/W | 71 lm/W | 25 | 50 lm/W |
| Mesopic factor | 1,05 | 1,05 | ✘ 0,95 |
| **Application end efficiency lm/W** | **74 lm/W** | **26 lm/W** | **47 lm/W** |

* Not valid for ambiente temp below 0°

**+ 57% higher Efficiency**

**LED Street Lighting System – based on OSRAM OS GD+ does have higher application efficiency of over 50%**

# Compare of LED and HPS in street lighting

| Light sources | LED OSRAM GD+ | FL | HPS SON-T PP 100W |
|---|---|---|---|
| CRI | 75 | 75 | 25 |
| CCT | 5500K | 5000K | 2000K |
| lifetime | 100.000h | 3-7.000h | 15-20.000h |
| ( 70% initial flux) @ 11h/day | about 20 years | 1-2 years | 3-4 years |

**For further cost saving with intelligent light control units**

**LED Streetlighting fixtures can be design dimmable 0-100%**

**Illumination can be adopted to any ambient light conditions**

# It’s Time…

## Economics Works!  TCO Break-Even in Many Applications (Best Economic Fit)

**LED systems decrease the TCO for several applications already today**

- → **Energy cost savings due to high efficiency on system level**
- → **Maintenance cost savings due to long and predictable service intervals**
- → **Cost benefits outperformed by added value**

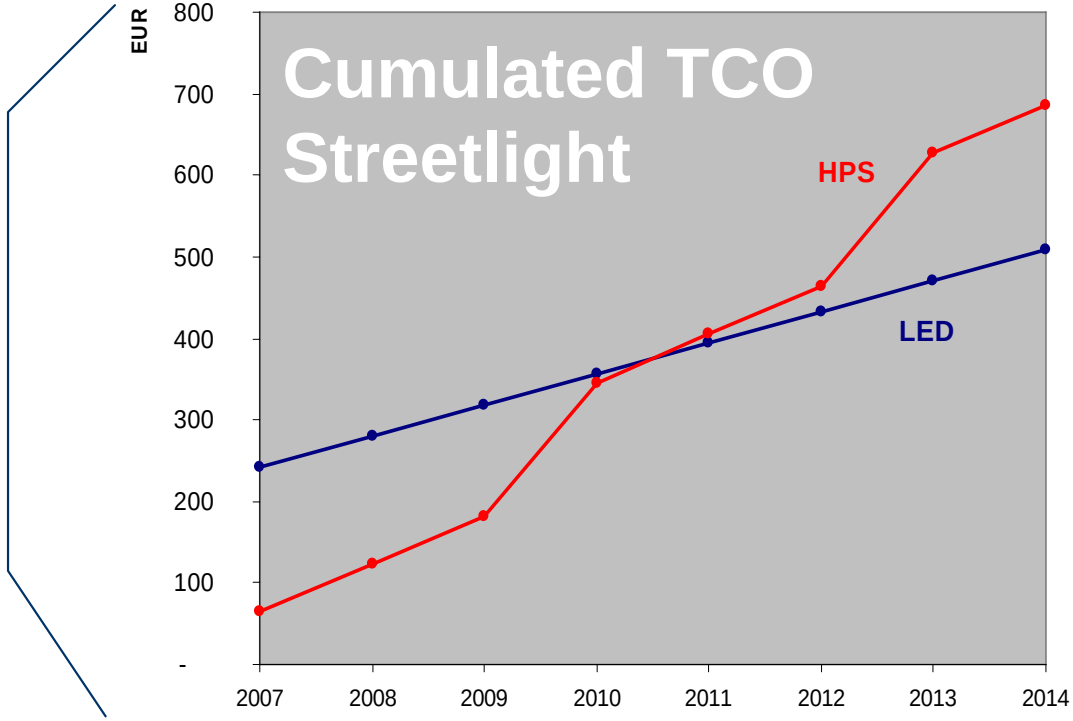
***Cost estimate (cost/year);***

*A) Cost of light source*

*B) Maintenance cost incl. light source*

*C) Energy cost*

***SUM  Total cost of ownership (TCO)***



# It's Time…
# to Contribute to Solving the Environmental Challenges

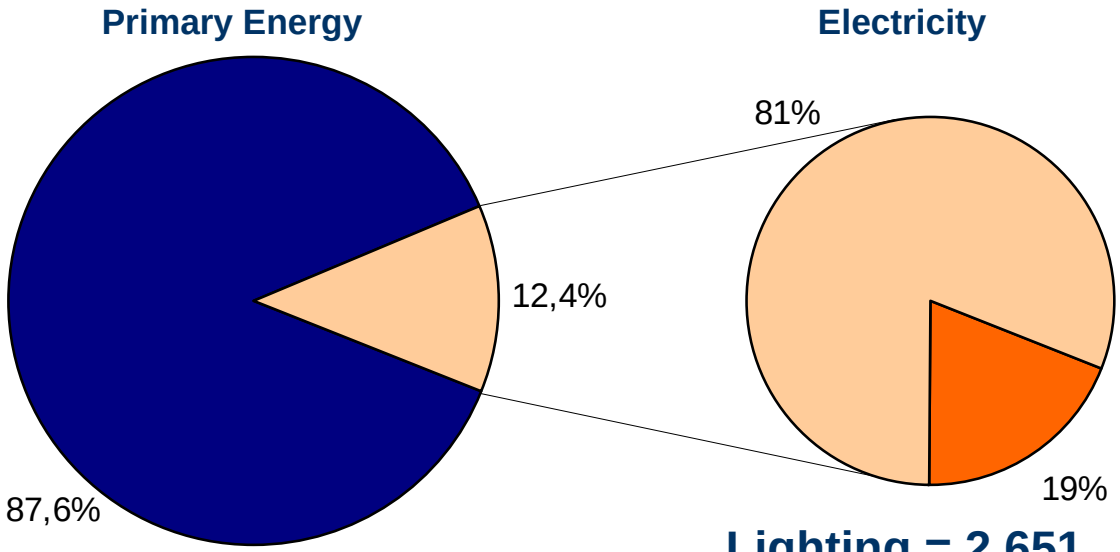
**Lighting** accounts for
**19%** of global electricity consumption

**2 651 TWh** were used for lighting in 2005
= total consumption of China and Japan

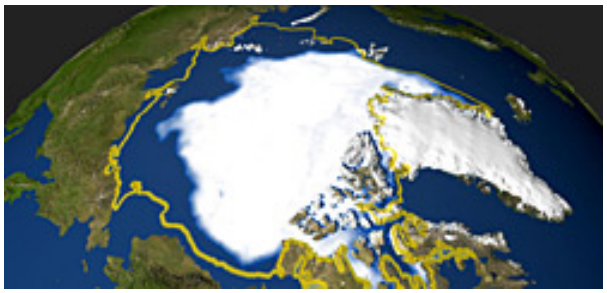
It would be *technically* feasible to **save about 50%** of this energy

If only 30% of the technical potential were realized…
260 million tons of $CO_2$ would not be emitted into the atmosphere!
(Corresponding to a new forest with the area of the Philippines)

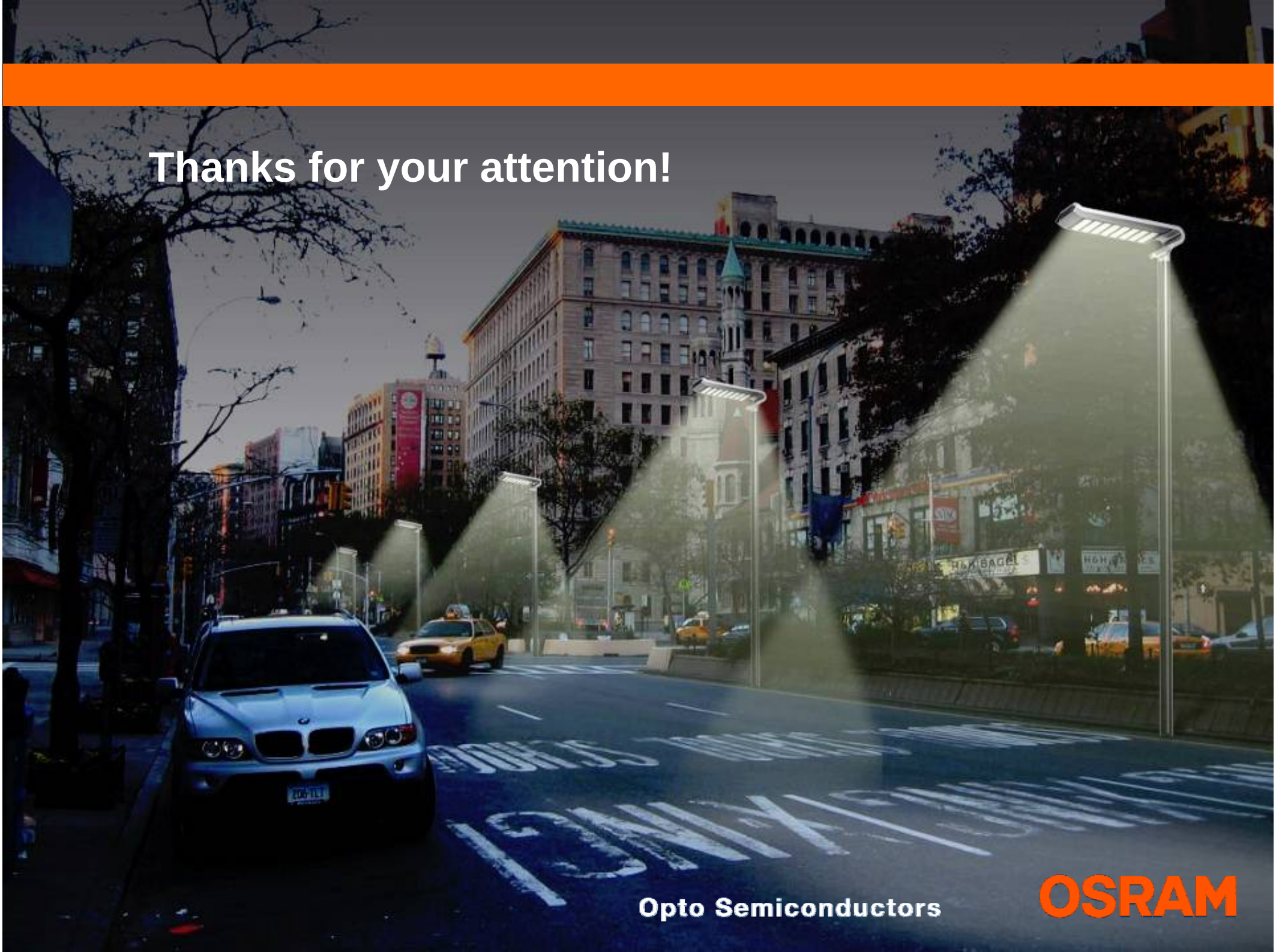
*IPCC: Intergovernmental Panel on Climate Change (Genève)*




**Lighting = 2.651 TWh**



IPCC climate report*: expected warming of 1,4 to 5,6°C in this century


Thanks for your attention!
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