LED Lichttechnik im Automobil
FachDialog Nanotechnologien

Uli Hiller | 27.09.2017 | BMUB Berlin

Light is OSRAM

OSRAM
Opto Semiconductors

LED Lichttechnik im Automobil
Agenda

1. LED Technology in a Nutshell
2. LED Eifficiencies
3. LED Lifecycle Assessment (Ökobilanz)
4. LED Applications and Trends for Automotive

Key markets of OSRAM Opto Semiconductors

Automotive

Forward Lighting

Safety

Personal Electronics

Bio Monitoring

Tablets I Monitors I TV I Virtual Reality

Multimarket

Video Walls

Projection

General Lighting

Outdoor Lighting

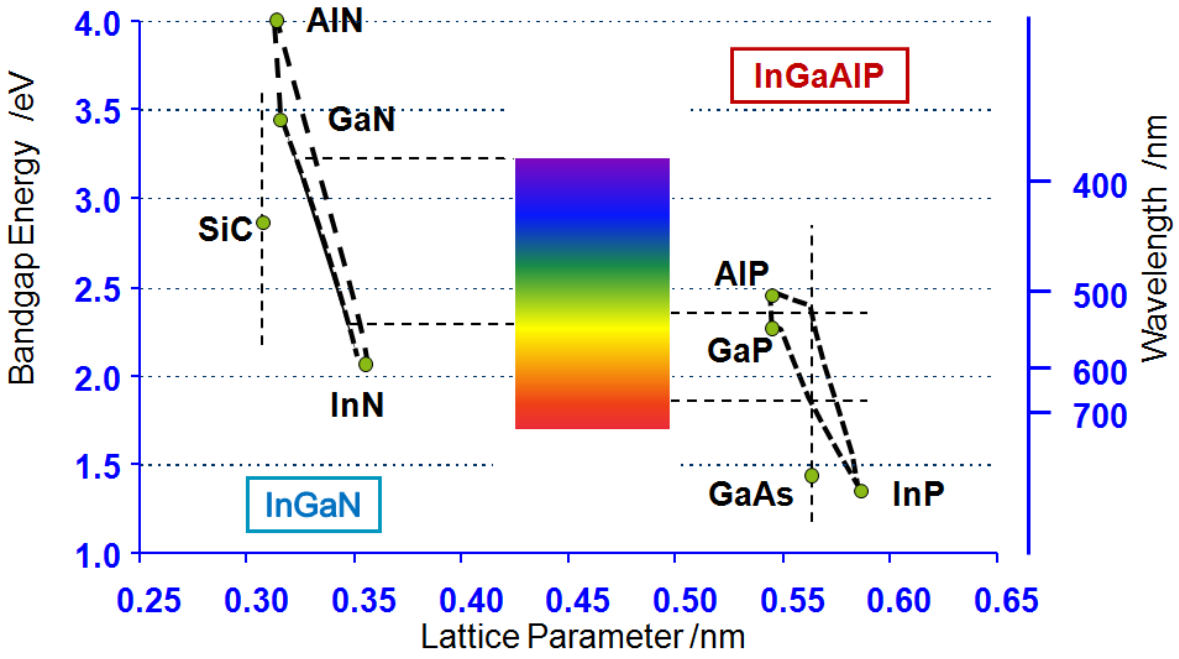
Residential Lighting

Material Systems for LEDs

InGaN

Blue
Green
“White“
“COD“

Bandgap Engineering



InGaAlP

Red
Orange
Yellow
Green

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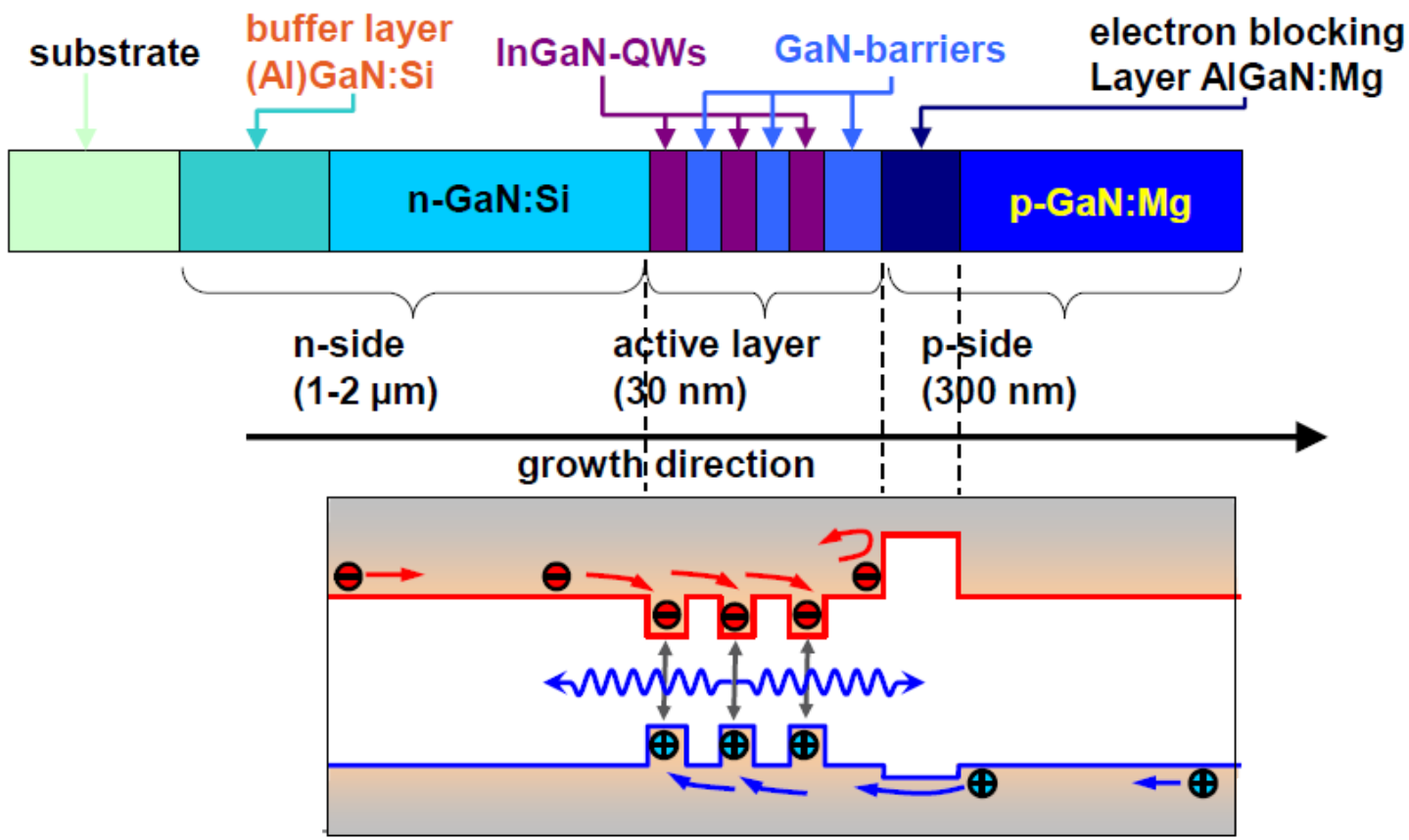
Internal LED Structure

Basic Schematic for InGaN



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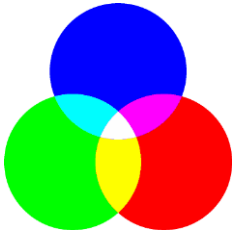
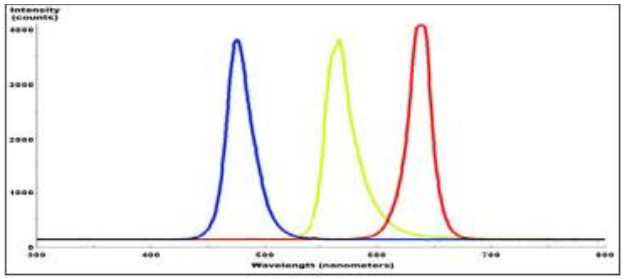
Different Ways to Create White LED Light

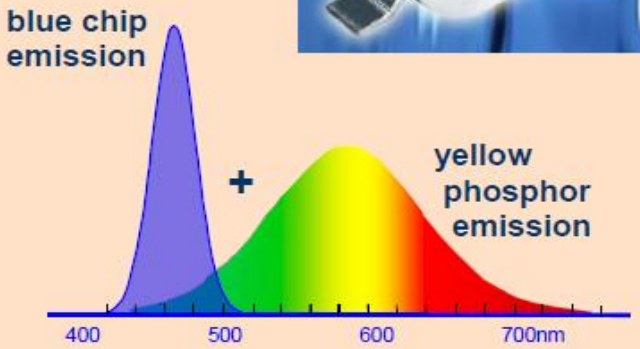
RGB Mixing of Light
Red + Green + Blue => White





- Driving of 3 chips is required
- Adjustable white point
- White point is very complex to control
- Low CRI (Color Rendering Index)

Blue LED With Partial Yellow Conversion
Blue + Yellow => White



- Easy to drive
- White point is “fix”
- No complex white point control necessary
- High CRI (due to broad phosphor emission)

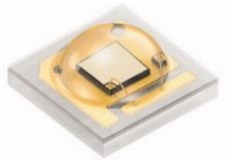
Our LED and IR product portfolio – outstanding …

… as one of the broadest portfolios of optoelectronic components in the industry.

Premold packages

Quad flats no lead (QFN)

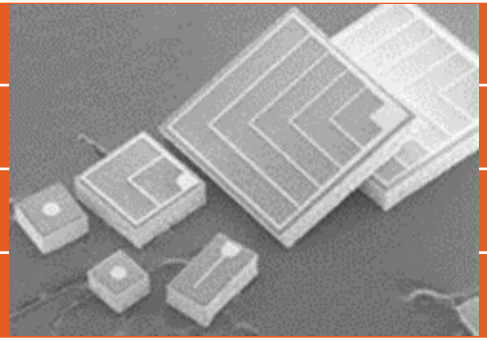
Ceramic packages



Molded inter-connect devices (MID)

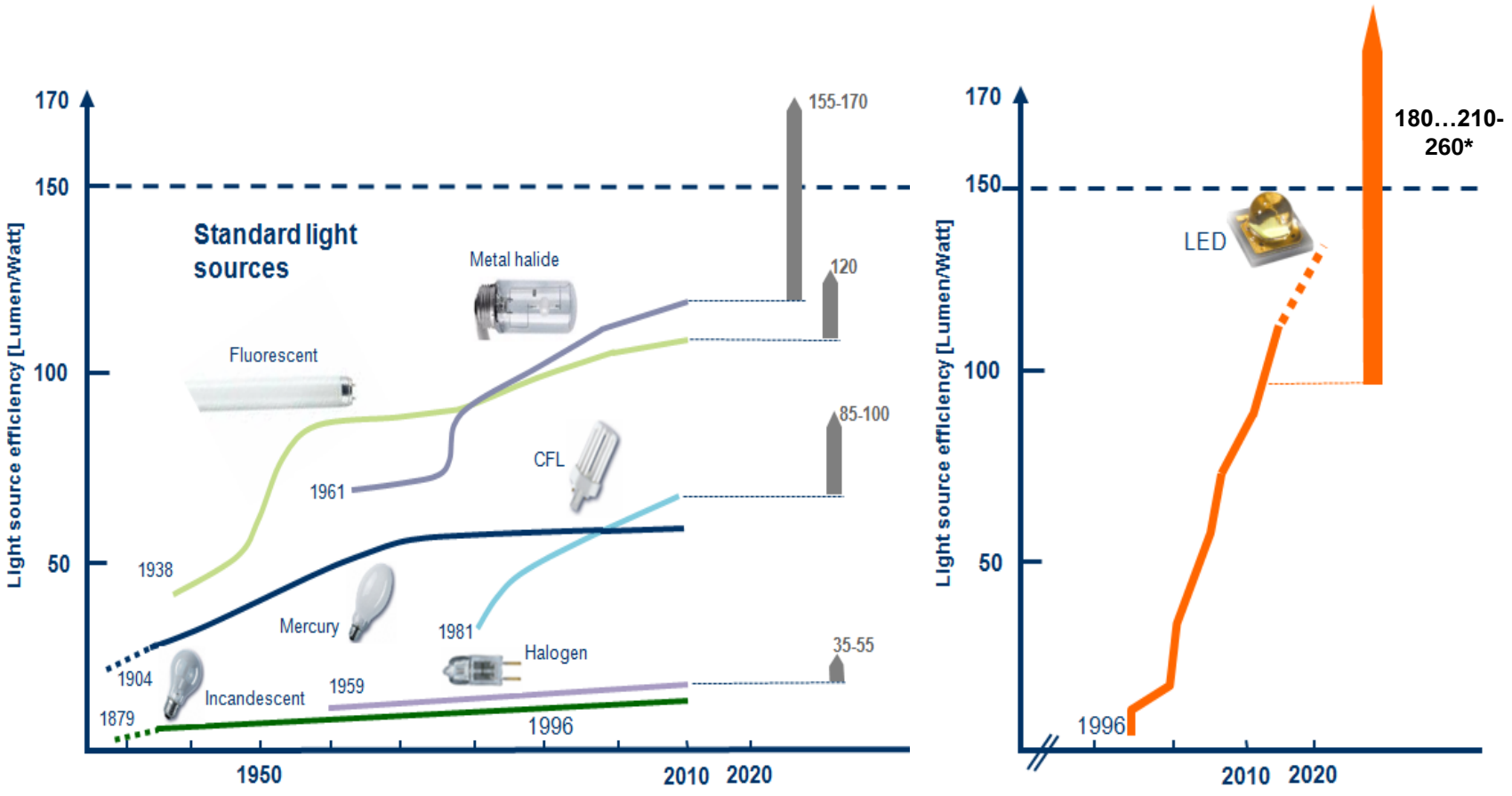
Chip-on-board packages

Light shaping technologies	Lens attach | dispensed lens | molded lens | glass attach | casting
Wavelengths	420 – 660 nm | 800 – 1000 nm
Chip technologies	Thinfilm | UX:3 | Silicon
Chip sizes (area)	0.017 mm² | 2 mm² | 16 mm²
Chip sizes (edge length)	130 µm | 1.4 mm | 4 mm



Potential of today's lighting technologies

LED is the most efficient technology



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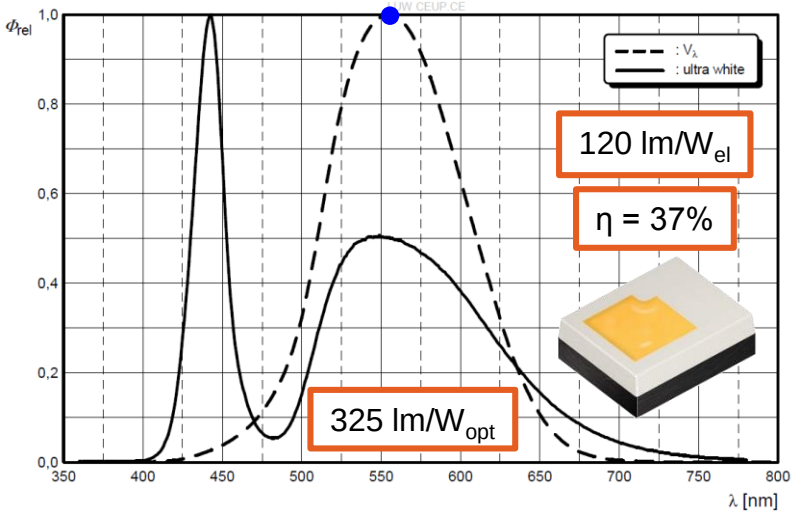
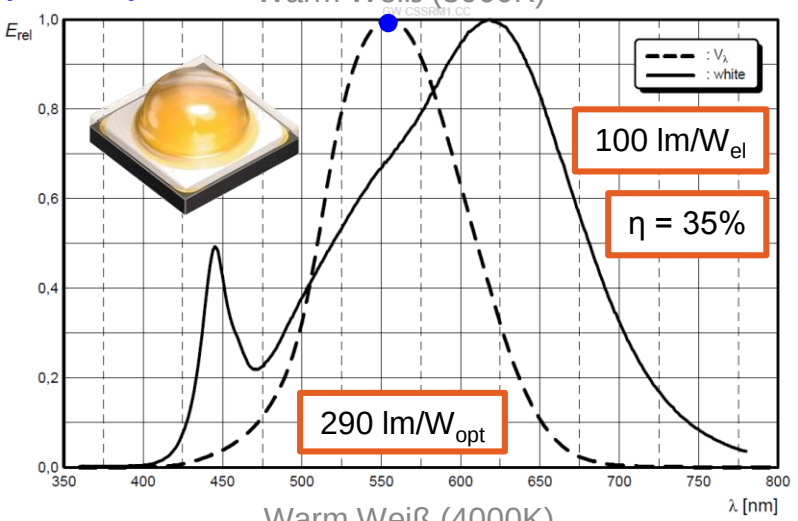
LED Efficacy Limits

Kalt Weiß (ECE/SAE)

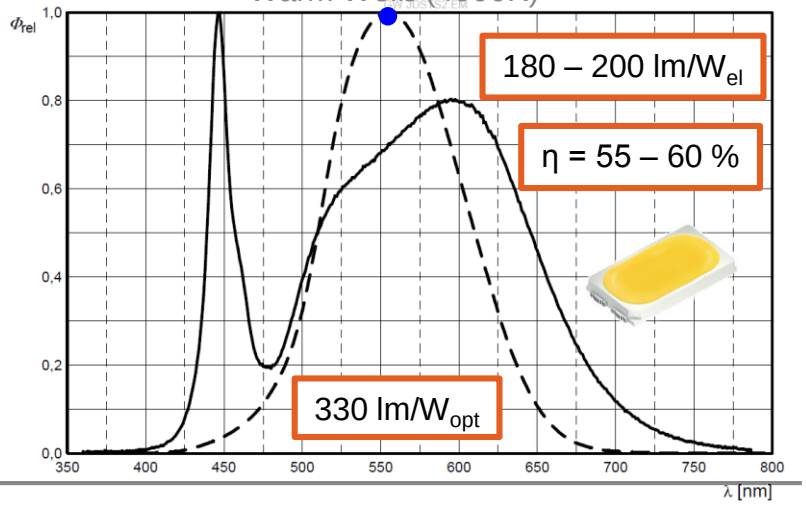
683 lm/W_{opt} (@555nm)



Warm Weiß (3000K)



Warm Weiß (4000K)

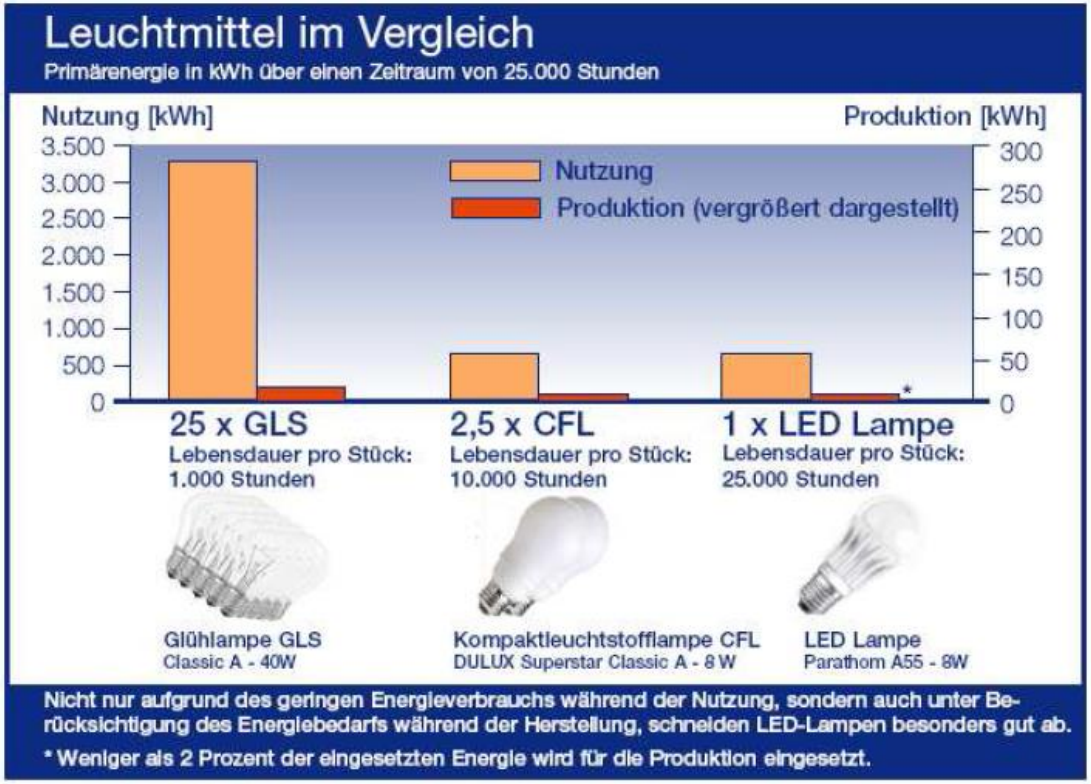


LED Efficacy Limitations (lm/W_{el})

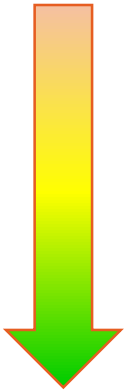
- LED Spectral distribution
- Conversion (Stokes Shift)
- Light Extraction (Chip & Package)
- Non-radiative recombination
  - via crystal defects
  - via Auger-electrons (I_f)
- LED serial resistance

LED Ökobilanz

Ergebnisse einer Gesamtlebenszyklusanalyse für LED-Lampen (OSRAM Opto Semiconductors aus dem Jahr 2009)



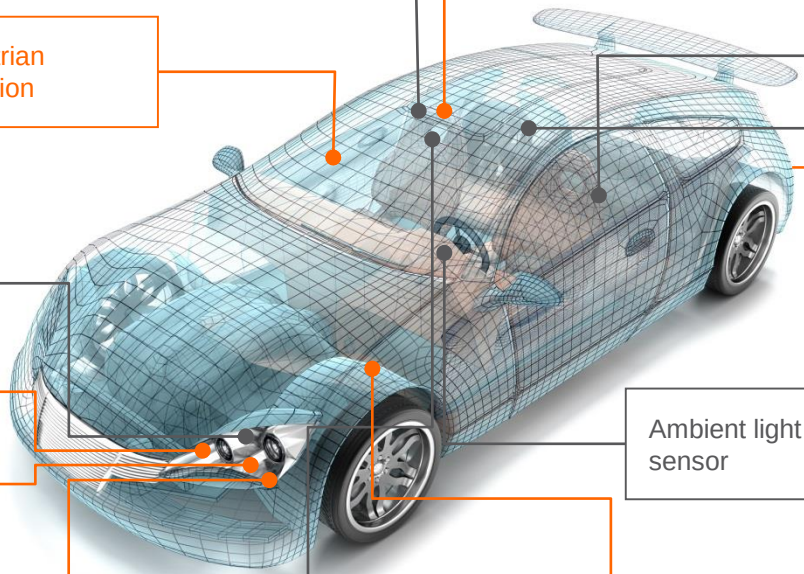
2009



2017

Study: Life Cycle Assessment of Illuminants: A Comparison of Light Bulbs, Compact Fluorescent Lamps and LED Lamps

Opto components drive automotive applications



Occupancy detection

Laser head-up display

Optical switches

Steering wheel angle sensor

Sun sensor for HVAC control (heat ventilation air condition)

LED head-up display

Adaptive cruise control system

Pedestrian protection

Family entertain-ment system

Night vision

Fog sensor

Daytime running light

LED headlamp

Ambient light sensor

Rear combination light (stop, tail, turn, backup)

Matrix headlamp

Laser headlamp

Cargo trailer illumination

Interior lighting
Ambient lighting

Rain sensor
Tunnel sensor

Side view and lane detection

Existing applications | Emerging applications

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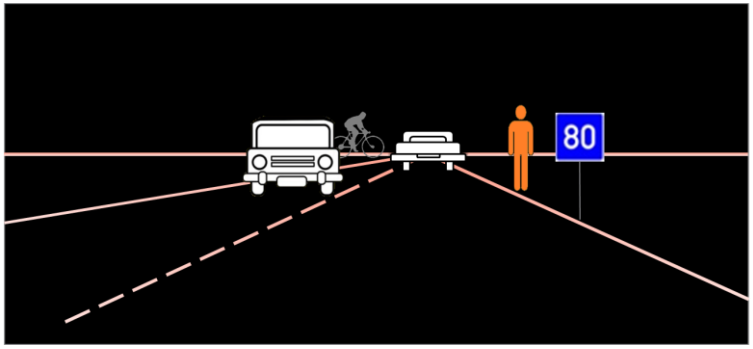
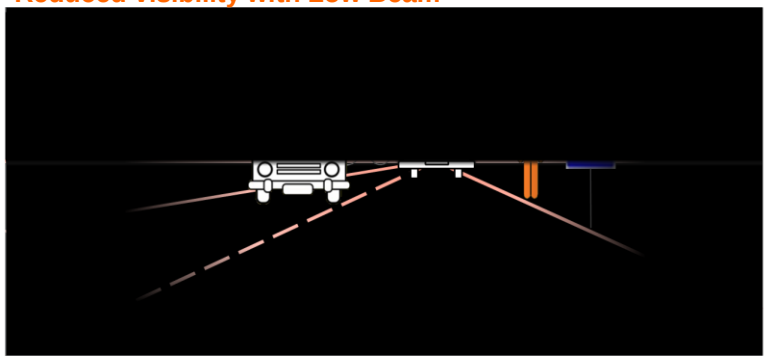
Adaptive Forward Lighting Systems (AFS)
Adaptive Driving Beam (ADB)

Better and individually controllable light distribution is key to increased safety and comfort.

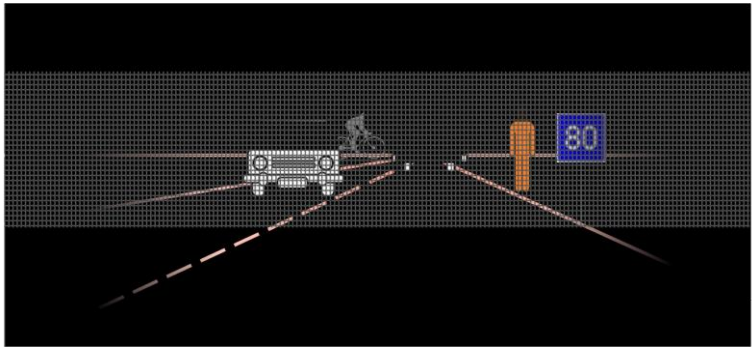
Complex driving situation at night



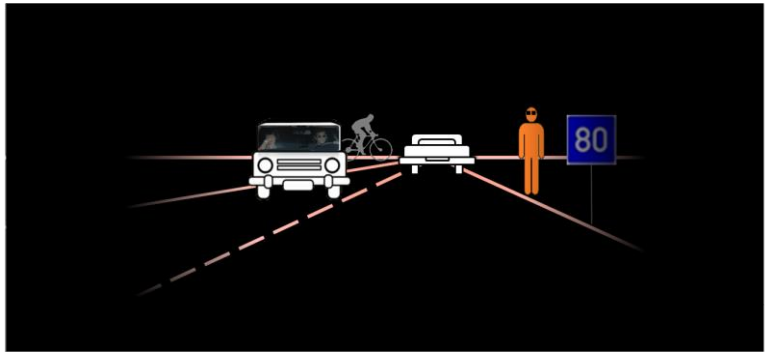
Reduced visibility with Low Beam



High-res matrix ADB



Glare with full High Beam



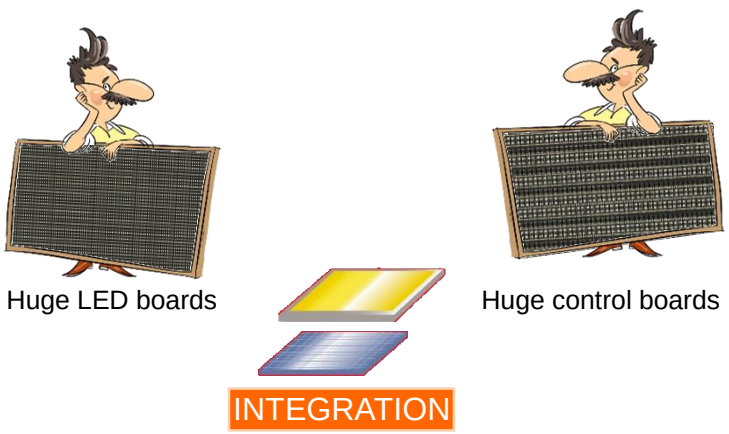
8 – 84 Pixel Systems based on discrete LEDs are currently on the street => Target > 1000 Pixels

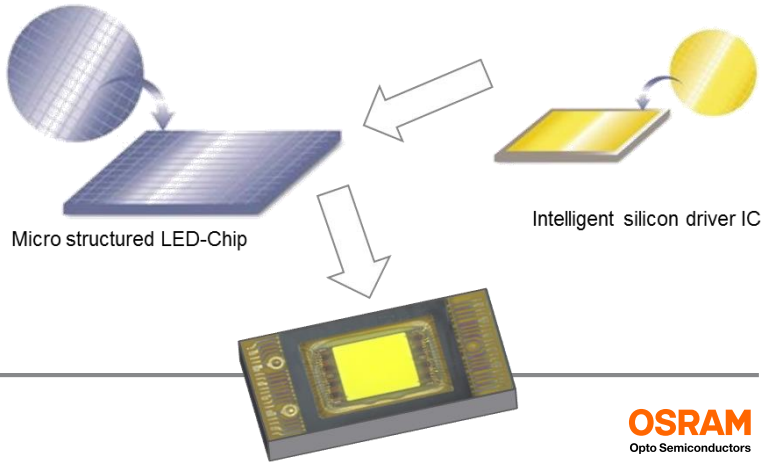
EVIYOS Pixel LED for AFS/ADB Applications

EVIYOS is an high-res and intelligent system for precise control of light distribution without complex electronics.

- Micro-structured Adaptive Front-lighting System
- Intelligent Si substrate
- High resolution active matrix LED array
- 1024 pixel in 4mm x 4mm (125µm Pixel Pitch)
- >3000lm light source, 3 lm per pixel @ 11mA
- Digital bending function
- Full digital beam steering
- SMT component

EVIYOS integrates LED and electronics into one compact and intelligent device





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Automotive Interior Applications and Trends

Applications

- Head-Up Display
- Displays
- Ambient Lighting
  - RGB static
  - RGB dynamic
- Functional Surfaces
- Display on Demand

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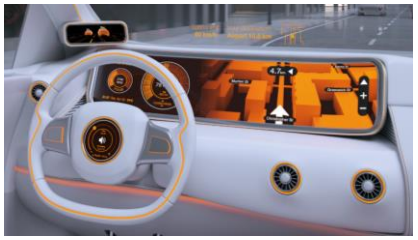
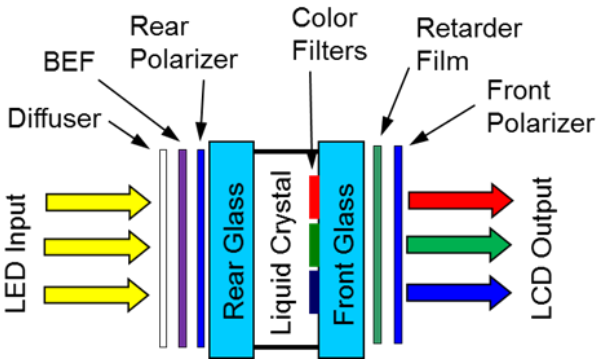
Display Solutions as of Today



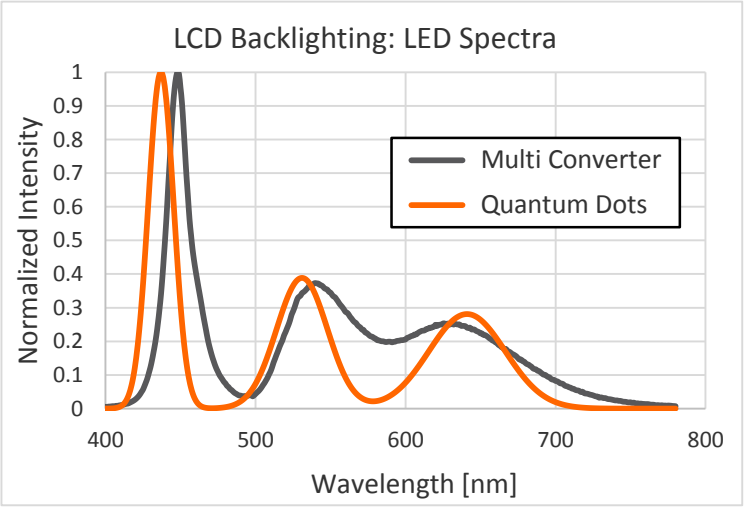
LCD is the Mainstream Technology

- Limitations Today
  - System Efficiency (≤ 5%)
  - Color Gamut
  - Contrast
  - Luminance



Quantum Dot Conversion for improved Color Gamut

- Use quantum dots (QD) for light conversion instead of classical converter material
  - QD have a size dependent band gap
  - Quantum Dot size ~ 2nm (B) – 7nm (R)
  - FWHM of emission ~ 40nm (G) – 60nm (R)
  - QD are sensitive to
    - Temperature, Humidity, Oxygen
  - High efficiency QD contain Cadmium (Cd)
  - Cd free QD have currently lower efficiency and larger FWHM
  - Narrow QD conversion leads to improved Color Gamut
  - Automotive and direct LED inclusion very challenging



Thank You

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