



BRIGHT MINDS,
BRIGHT LIGHTS.

Exterior Lighting
ZKW & LG
2019 DVN US Workshop
Ralf Klädtke
January 15-16, 2019





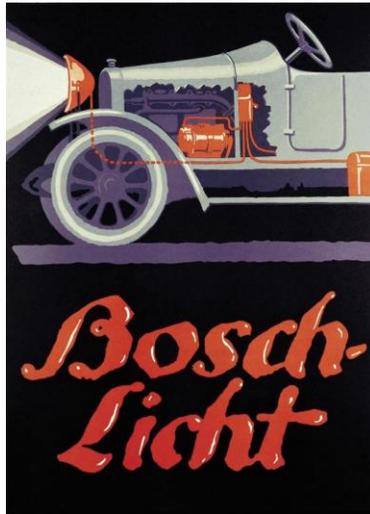
History of Car Lighting >> towards Safer, Smaller, Smarter Lighting Technologies

Candles/
Carbid Lamp

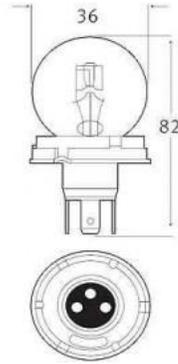


1886
Gottlieb Daimler

Electric
Lamp



1913
Bosch Electric
Light



1936
Bilux
Light



1971
Halogen
Light



1991
Xenon
Light



2002
Adaptive
Front
Light



2014
Laser
Light



Full-LED-Laser-HSW

Today
Projection
DLP
LCD
Micro
Matrix
Laser
Scanner
OLED
MLA
Sensor
Integration
Light





ZKW 2019:

- >1,6 billion USD Revenue
- >10.000 Employees

Locations





Passenger Car main market focus in all segments – Motorcycle and truck secondary market

Market
(representative examples)

„Secondary“ market

Motorcycle



Main market focus

Passenger cars



Small truck



„Secondary“ market

Truck



**Passenger car-
Segments**
(representative examples)

Entry



Skoda Rapid

Mid



Audi Q3

Premium



BMW 5er

Luxury

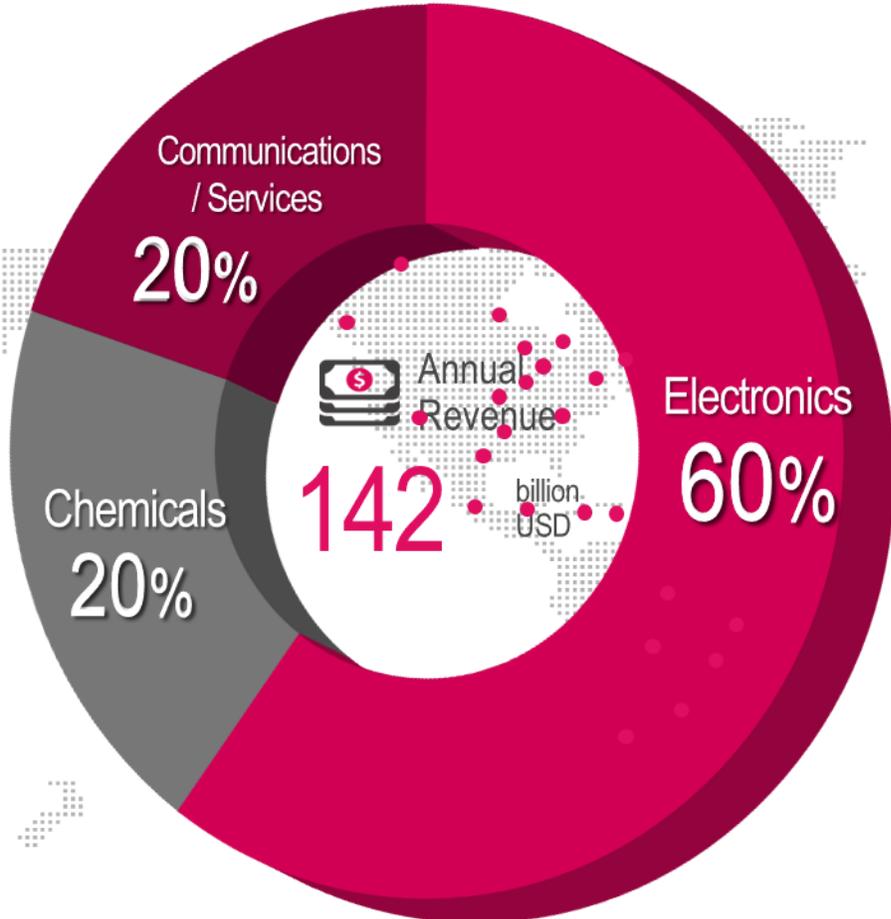


Porsche 911



LG Global Business Status

▶ 230,000 employees worldwide ▶ 2017 Annual revenue by affiliates





LG Automotive Components Overview

▶ Automotive components for eco-friendly vehicles based on cumulative capacity over years in electric, electronics and components

LG Electronics

- Telematics
- AVN*
- HVAC**
- EV components
- Rearlamps



LG Chem

- EV battery
- Engineering Plastic



LG Display

- In-vehicle Display
- OLED for Rearlamps



LG Hausys

- Automotive skin
- Lightweight components



LG Innotek

- EV components
- High-powered LED



*AVN : Audio, Video, Navigation
 ** HVAC : Heating, Ventilation, Air Conditioning



ZKW & LGE Lighting – Joint Global Footprint



- LGE IVI & ePT
- LGE Lighting
- ZKW





LG Science Park

▶ Center of R&D innovation to prepare for next 100 years

- Open on October, 2017
- Floor area : 1,108,430 m²
- Max capacity : 23,000 researchers
- Investment : \$3.5 billion





Future lighting trends require ZKW to become solution provider for Exterior Lighting

Megatrends and their impact on automotive lighting

 Individualization	Design & Styling of main headlights <ul style="list-style-type: none">• New technologies for styling effects	Miniaturization of lighting modules / compact models / Micro Lens Array <ul style="list-style-type: none">• Lighting modules• Exterior Displays: Integration of consumer technologies
 Digitization	New lighting functions <ul style="list-style-type: none">• Digital lighting at high resolution• Individualization/adapting lighting functions• ADB• Digital Light/Sensor Fusion	High-resolution <ul style="list-style-type: none">• DLP, Laser Scan, Micro LED• Industry 4.0:• Manufacturing Methods• Engineering Methods
 E-Mobility	<ul style="list-style-type: none">• High efficiency / low weight lighting technology and concepts• Basic technology for main headlights	<ul style="list-style-type: none">• Basic technology for passenger cars, motorcycle, auxiliary and additional lights
 Autonomous driving	<ul style="list-style-type: none">• Sensor Integration & Cleaning• ECU/Software/Power Computing/BUS Systems• Sensor Data Processing/Sensor Fusion Algorithms	<ul style="list-style-type: none">• Light Communication/ Connectivity• New Business Models – Social Behaviour Change• ADAS• Rear lights (RCL)• 360° camera vision/integration



Market Trends – Design & Styling for Exterior Lighting

SMALLER & SMARTER





Market Trends

Supplemental Lamps – Design & Styling Trends

- **Styling trends for Supplemental Lamps**
 - Dynamic lighting and animation
 - Logo Illumination
 - Welcome function
 - Light guides
 - Glowing Bodies
 - Projections
 - Corporate signatures





Market Trends

SAFER & SMARTER

“Digital” lighting for conventional cars & AV
New Communication Functions - SAFETY

■ Car to Driver

- Construction guidance lighting
- Obstacle avoidance lighting
- Optical lane assist lighting
- Warning functions



Obstacle avoidance



Construction Guidance



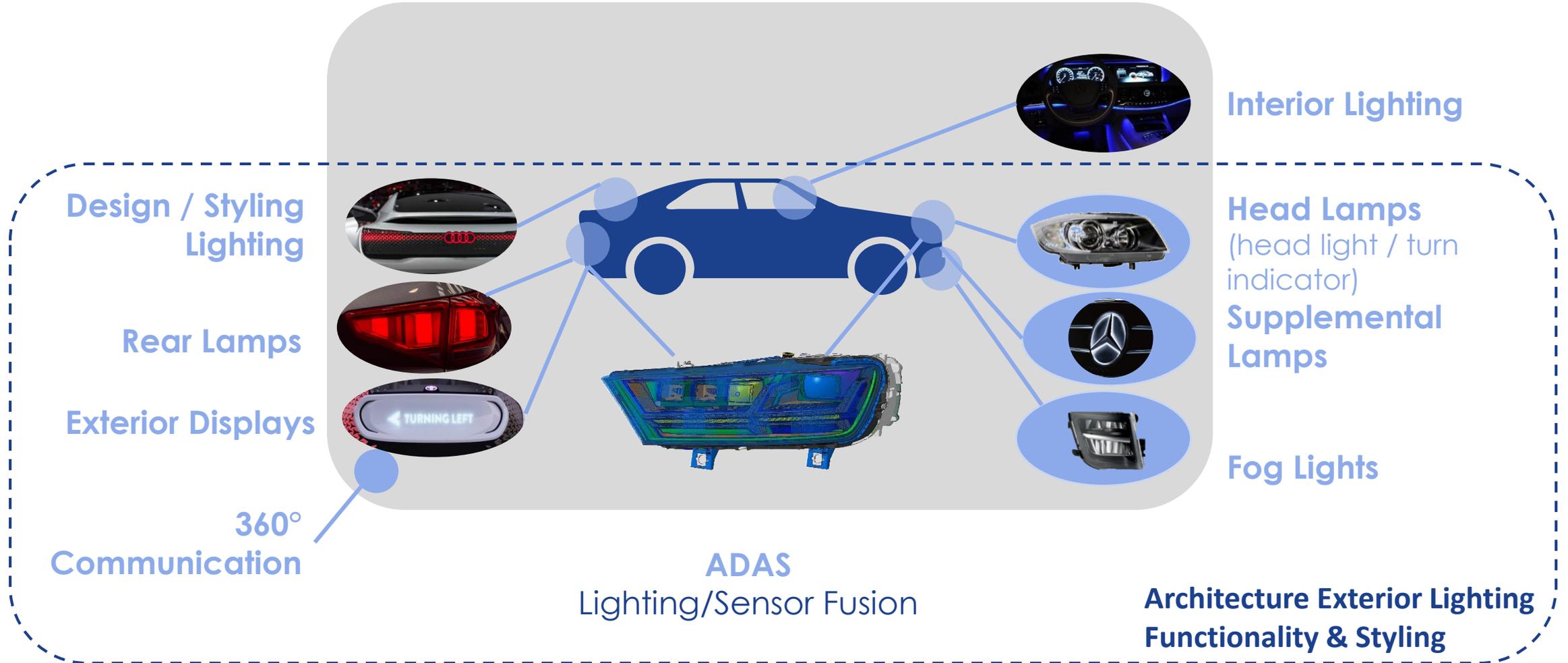
Rear projection of caution lights



Warning stripes

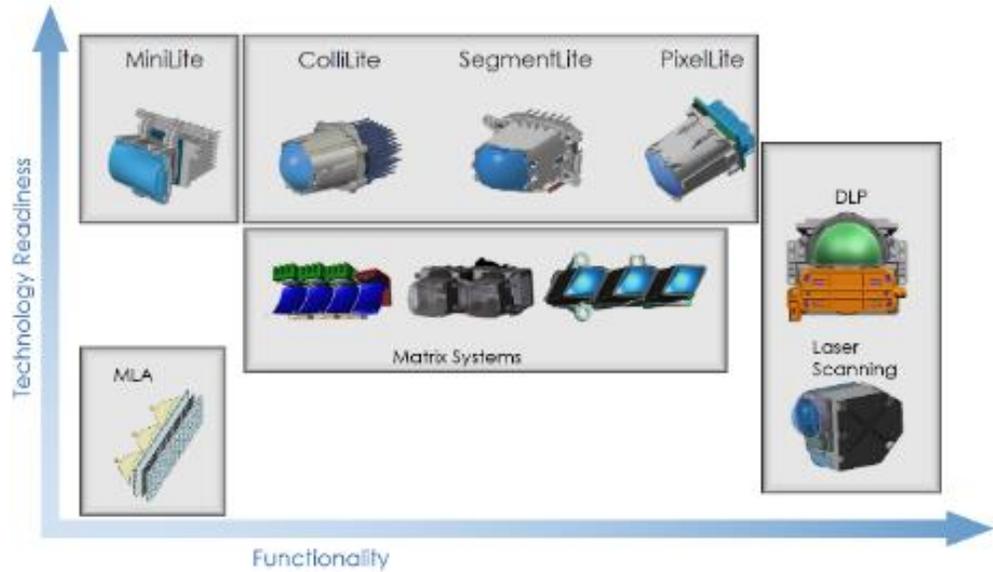


ZKW – Solution Architect for Exterior Lighting



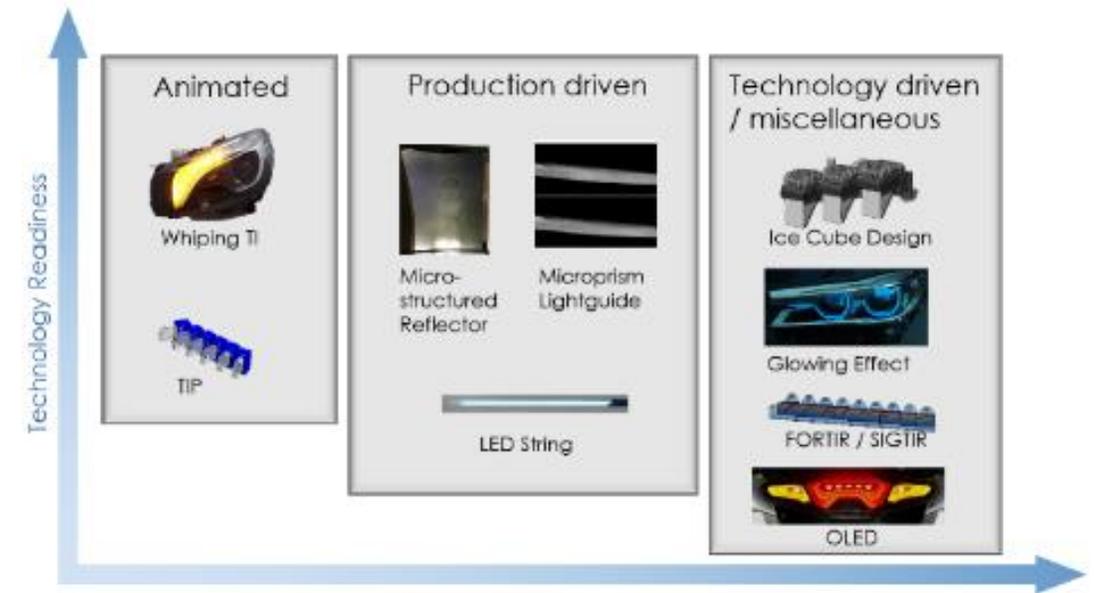


ZKW Product Overview



Functionality driven Products

Design/Styling driven Products





ZKW covering major trends



Smaller
Safer
Smarter



Miniaturization



Efficiency



Light & Sensor Fusion



Styling & Customization



Cost Down

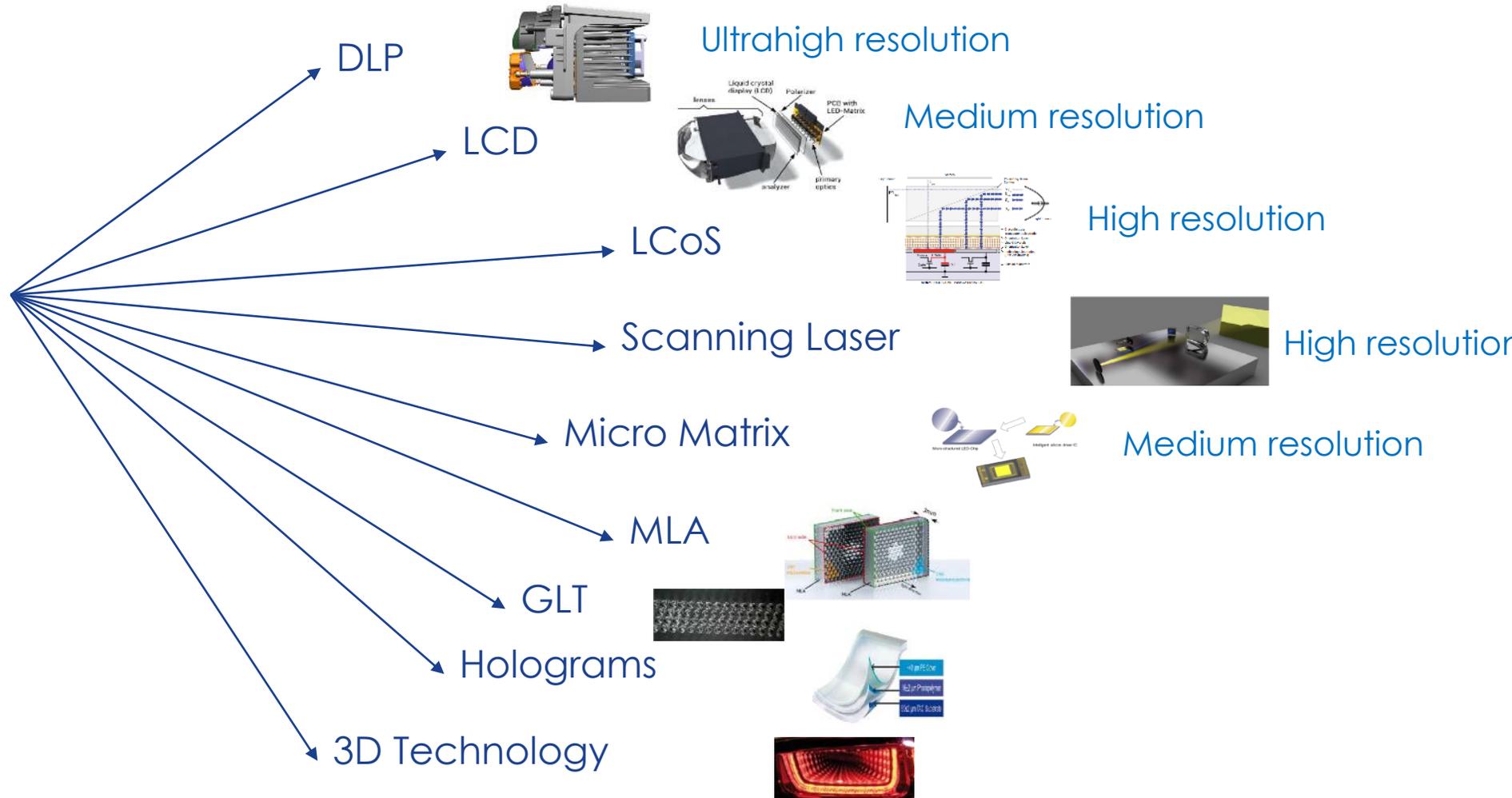


New functions



Technologies & Products

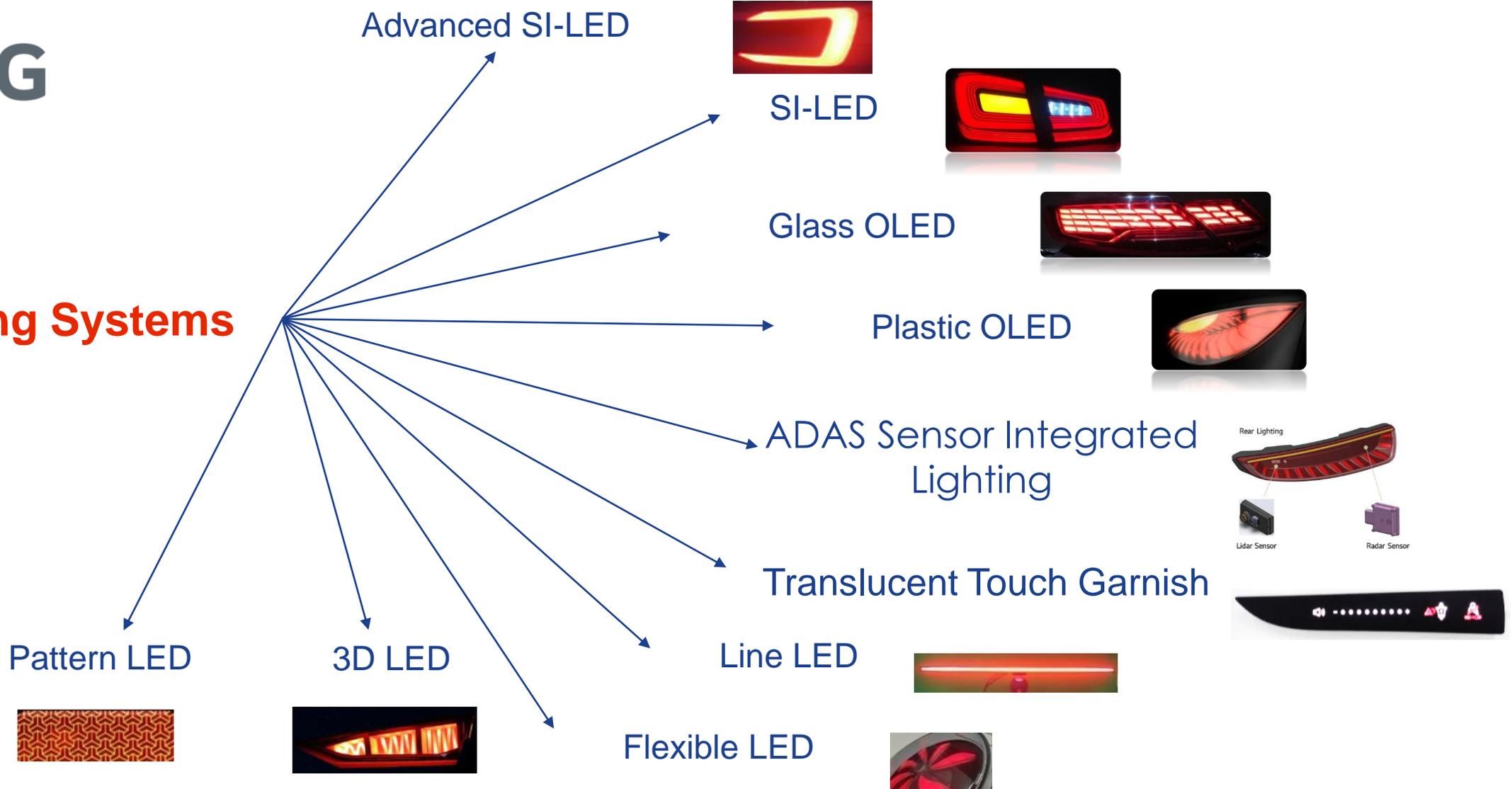
Lighting Systems





Technologies & Products

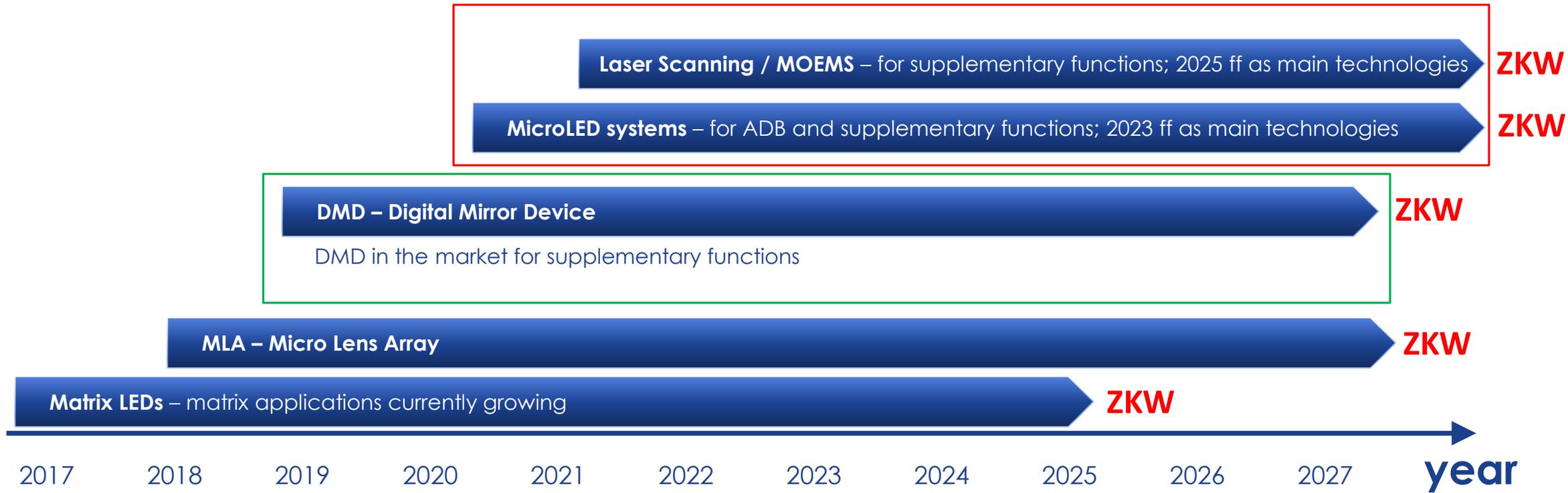
Lighting Systems





Roadmap of Technologies

PROJECTION Technology Roadmap – market introduction





Miniaturization – stripeZ Compact Module Family

Motivation

Approach for ,narrow headlamps' and for ,better' utilization of the installation space.
Closing the gap in the product portfolio with powerful low-height modules



Function

- Foreground
- Low Beam
- High Beam
- ADB High Beam Matrix
- ADB/AFS Pixel



Facts

- + Strongly reduced Lens height
- + 1 family for all main lighting functions in a consistent design language
- + Light performance comparable to „bigger sized“ modules
- + Scalability in terms of performance
- + Various combinations
- + ECE, CCC and SAE (incl. IIHS optimized version)

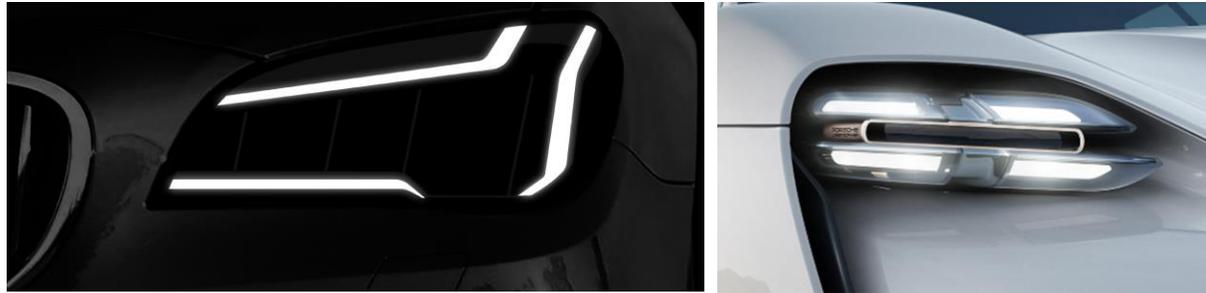


MLA – brickZ Micro-Lens-Array

SMALLER

Motivation

Headlamp technology for realization of complex stylings of low beam and high beam function.



Low beam / high beam can be realized in similar styling as DRL

Function

MLA is an array of small convention projector systems. MLA components can be made of plastic, glass or fused silica. Size and shape of the arrangement micro lenses are variable across the MLA. Light from a LED board is collimated on the MLA.

Facts

- + Very high design affinity
- + Very low installation depth
- + Homogeneous light impression



ZKW Prototype



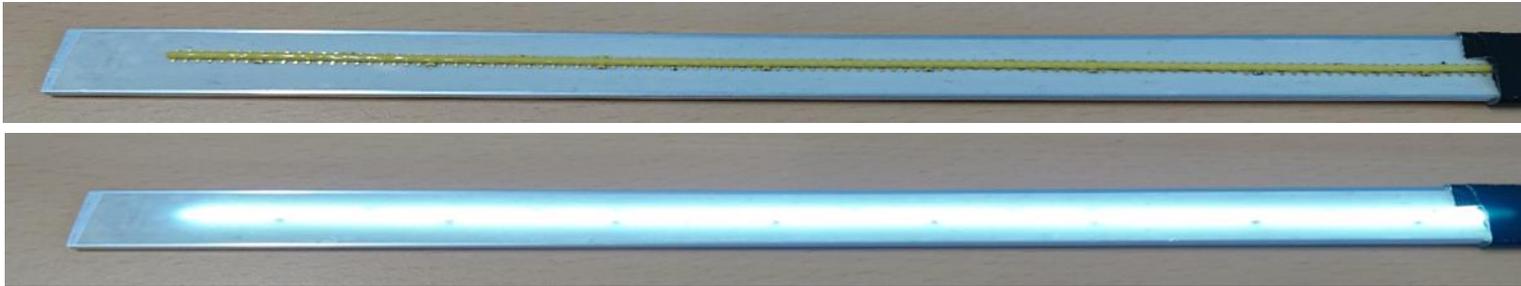


LED - String

SMALLER

Motivation

Signal light functions such as daytime running lights, direction indicator or tail light by means of a very thin illuminated surface - freely designable



LED String - WHITE

Facts

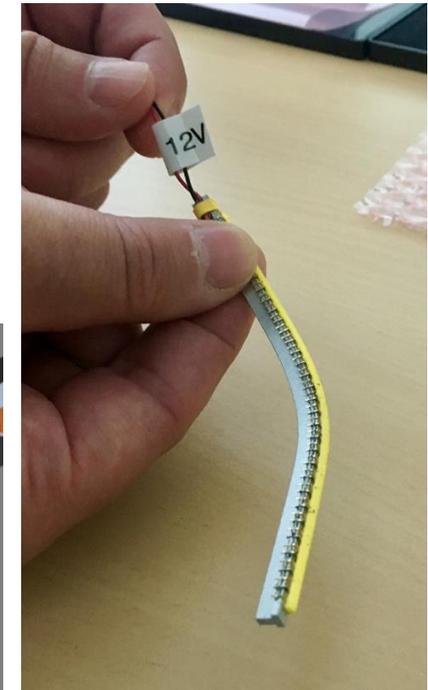
- + Very thin design contours can be realized
- + Very low installation depth
- + High efficiency
- + Segmentable - Dynamic functions

Function

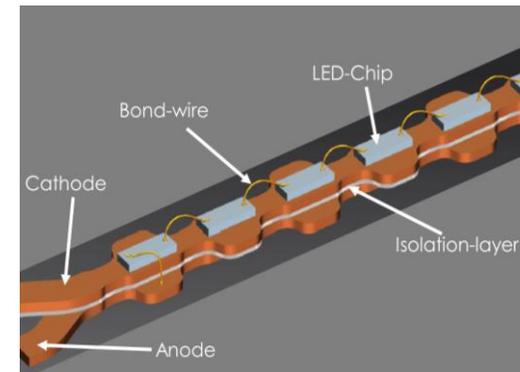
Arrangement of very compact LEDs in the form of a string with the least (not visible) distance.



LED String - RED



Flexible Design Concept



Design Concept

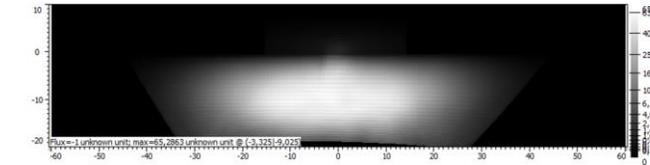
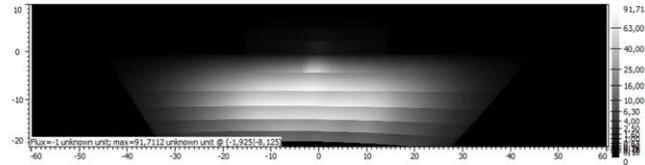
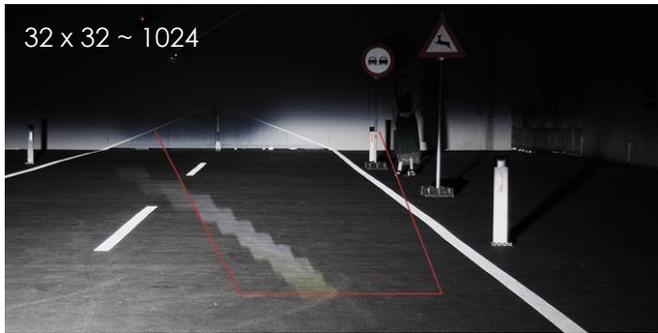


MicroLED

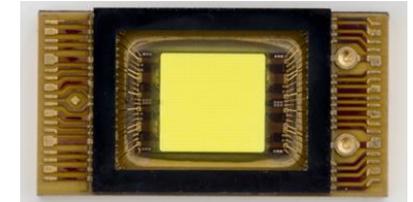
SMARTER

Motivation

Development of a new Generation of pixelated AFS/ADB module, with increased resolution compared to todays available module generations.



MicroLED



Function

Light source consists of a Pixelated LED-Array

- Foreground projection
- High Beam
- ADB High Beam - Matrix

Facts

- + approx. 20.000 Pixel
- + High resolution with increased efficacy
- + reduced optical complexity
- + Full high beam field of view

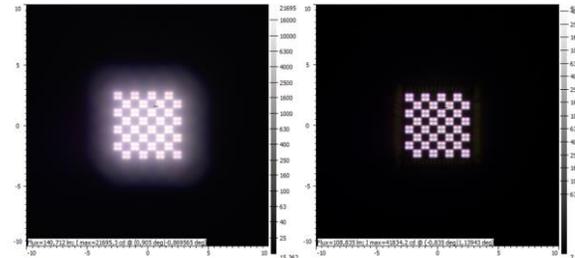
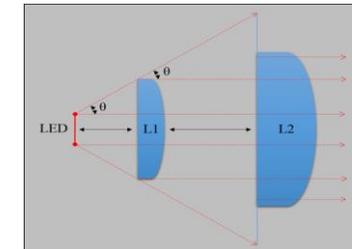


Image quality vs efficiency



Optical concept



μAFS Chip – EVIYOS Gen 1



DLP 2.0 – mirrorZ

SMARTER

Motivation

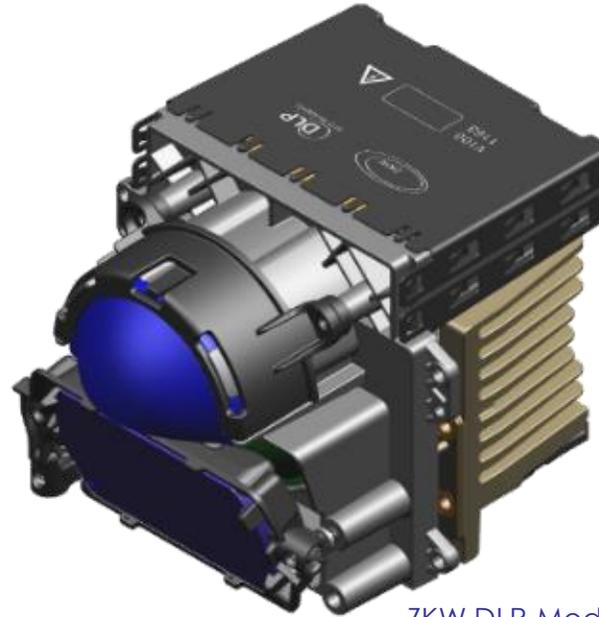
High-resolution headlamp technology to optimize the illumination and projection of symbols in front of the vehicle



Projecting guideline on the road increases safety

Facts

- + High resolution 1,3 Mio. Pixel
- + Sharp projections - images
- + Today available



ZKW DLP-Module

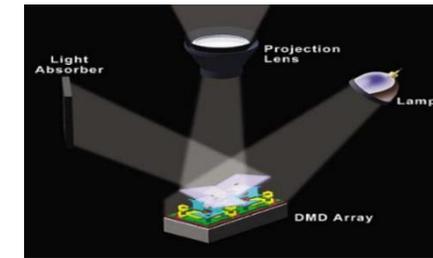
Better smoother illumination with high beam increases safety



Function - Concept

Controlling of light by means of many small micro mirrors arranged in an array.

Each mirror can tilt in 2 positions. In one lets the light through - gives a white pixel - in the other case, the light will be directed into an absorber and leaves no light through the optics - black pixels.



Principle



DLP Chip 1,3 Mio mirrors - pixels



Tilting mirrors



Laser Scanning Module - horizonZ

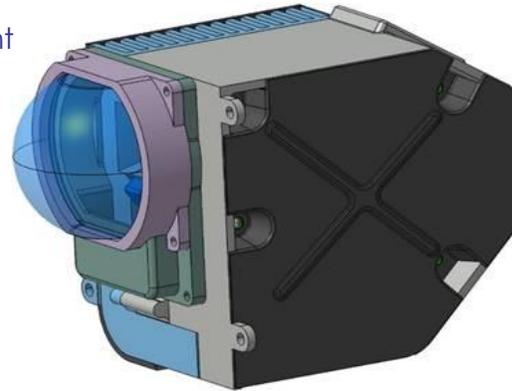
SMARTER

Motivation

High resolution headlamp technology for optimized illumination and maximum range



Projection of marking light increases safety

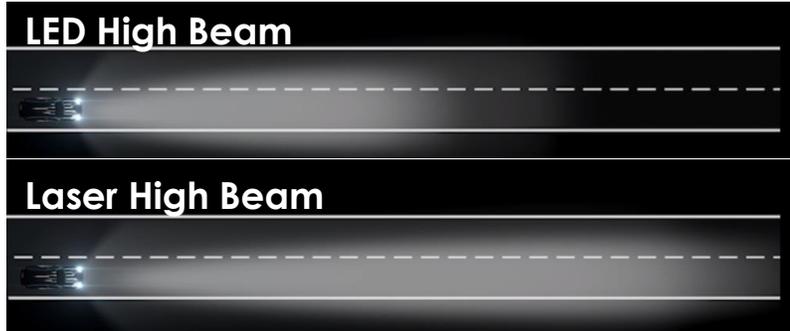


ZKW Laser-Module

Better illumination and increased range of Laser Beam

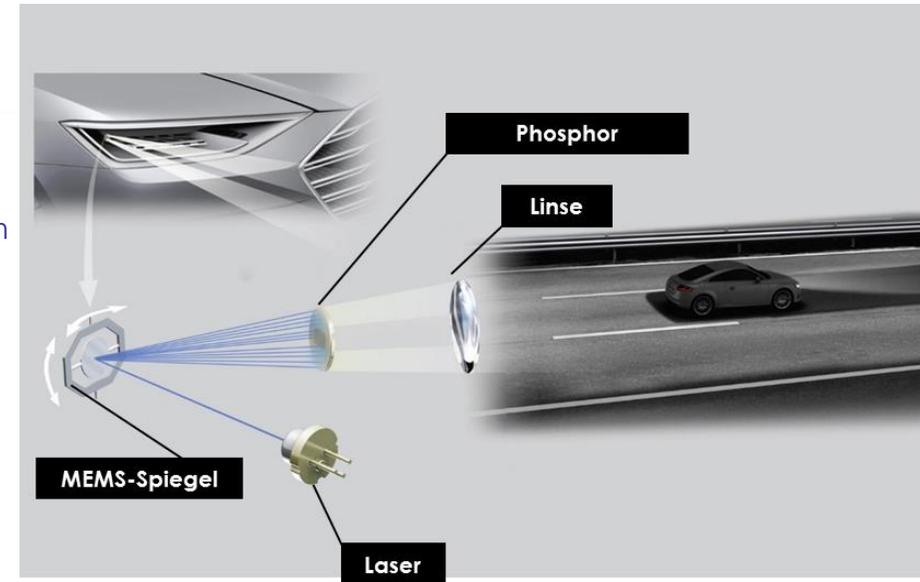
Facts

- + Very high brightness - range
- + Good efficiency
- + Wider market of core components



Function

A blue laser beam is incident on a MOEMS (Micro-Optical Electromechanical System), which reflects into a yellow phosphor. The moving MOEMS scans over the phosphor, and at each position white light is generated as an admixture of blue laser light and yellow phosphor light.





Flexible LED Rear Lighting



Product Overview

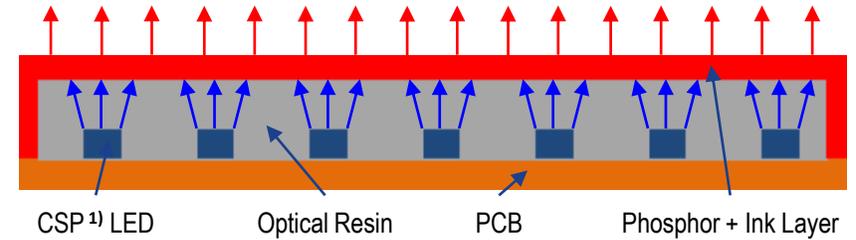
- Thin, Flexible 5-direction light emission with homogenous lighting
- Meets various requirements for vehicle design
- Possible for all function of Rear Lamp With DRL
- Bending Radius >100mm



SMALLER & SMARTER

Features

- Emitted from the chip reacts with the red phosphor to emit red light.



1) CSP : Chip Scale PKG



Glass/Plastic OLED Rear Lighting

Glass OLED Product Overview

- Light Uniformity
 - > Over 90% Light Uniformity
- Volume and Weight Reduction
 - > No Air Gap and Diffuser
- Individual Panel Control
 - > Animated Sequence Available
(Ex. Coming Home, Leaving Home, Battery Charging Mode, Etc.)

Plastic OLED Product Overview

- Design flexibility
 - > 0.4mm(0.01inch) thick
 - > Bending radius > 30mm
- Volume and weight reduction
 - > No air gap and diffuser
 - > Reduce dummy zone up to 90%
- Individual panel control
 - > Animated sequence available
(ex. Battery charging mode, parking mode, etc.)

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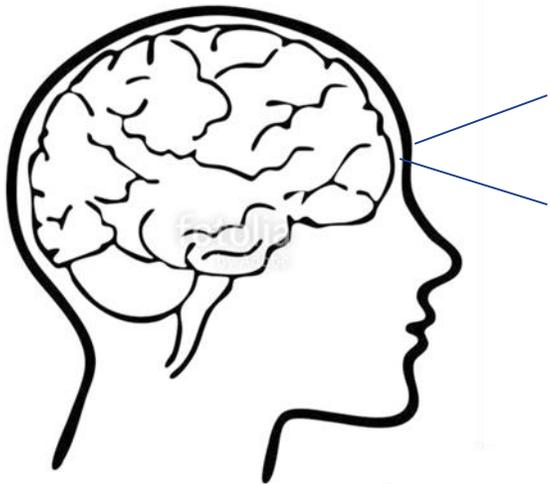


Flexibility

Segmentation

Manual Driving Architecture

2 visual sensors
(eyes)
+
brain

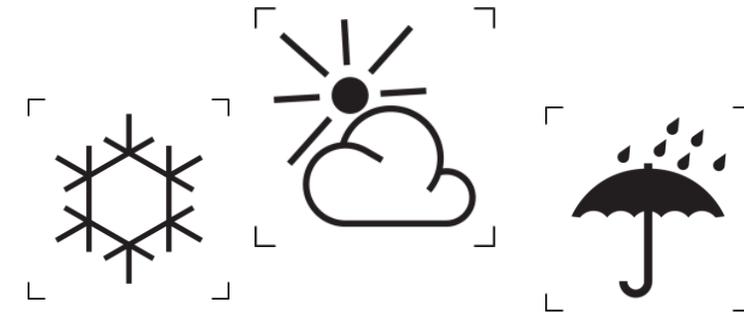


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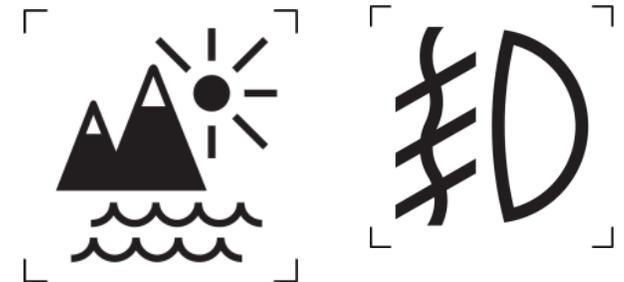
Lighting



=



**ALL WEATHER
Capability**

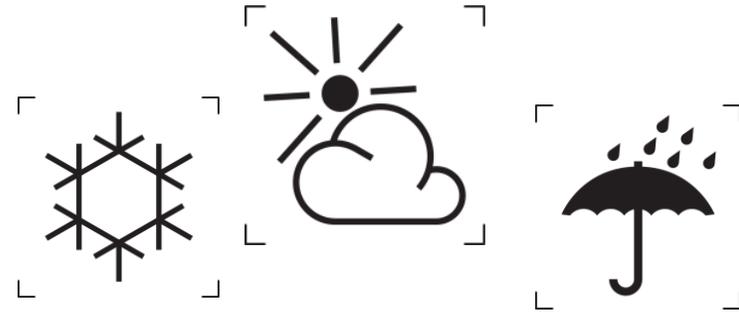
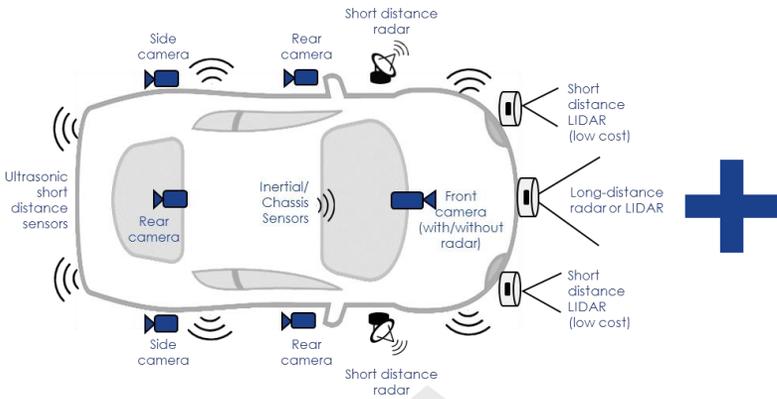




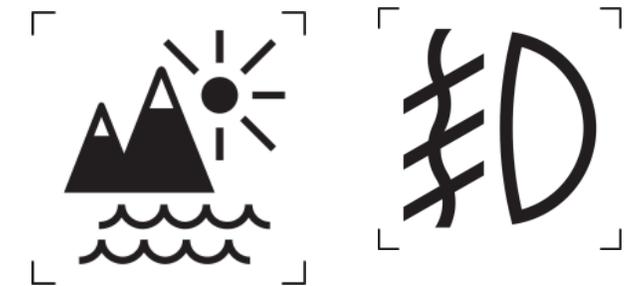
ADAS Driving Architecture

SMARTER >> towards AI Automotive Lighting

Visual Sensors
Radar
LIDAR
IR, MS, ..
+
Artificial Intelligence (AI)



**ALL WEATHER
Capability**



ADAS Level 4/5
 Σ 28-50 Sensors

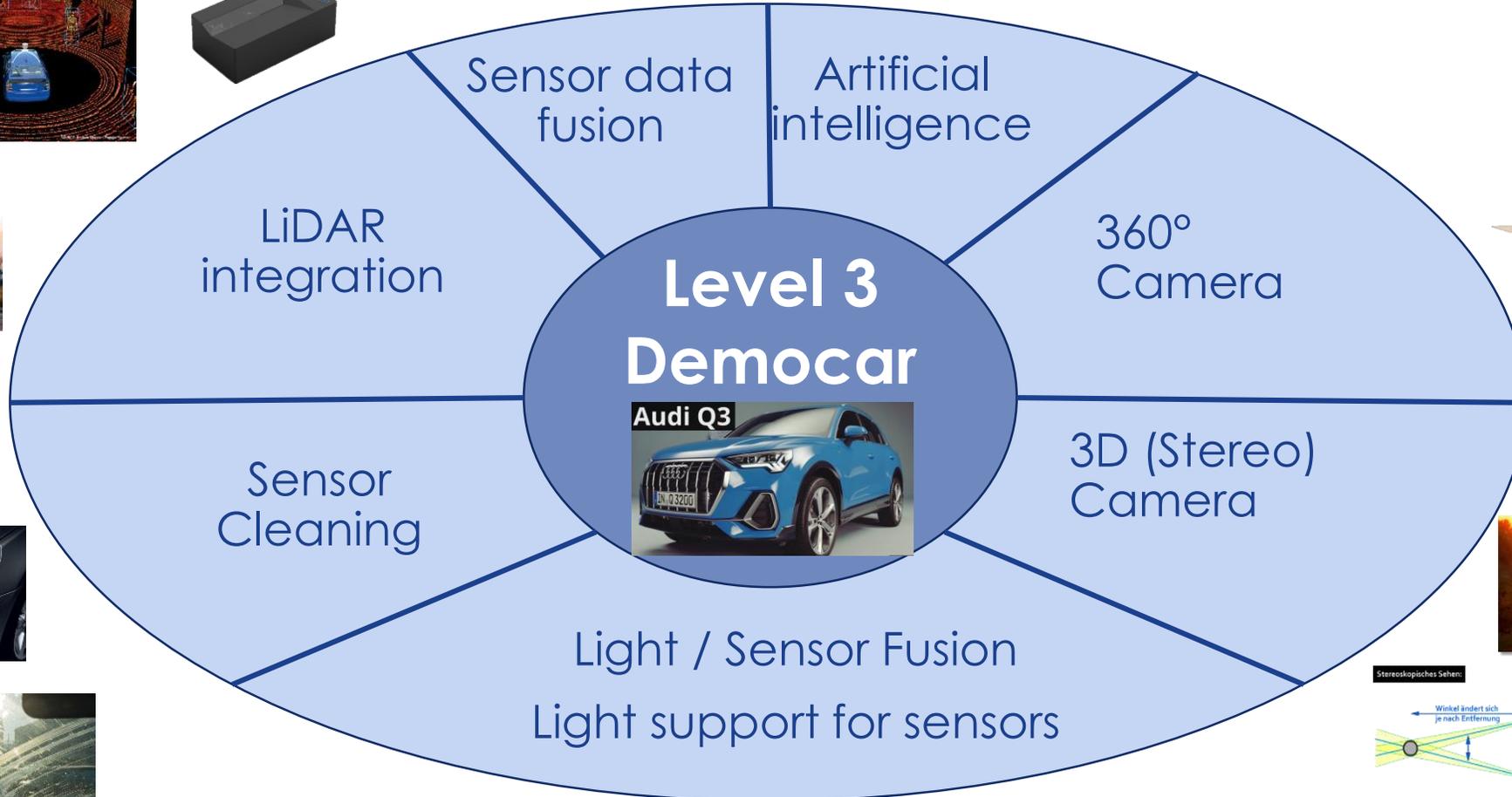


ZKW covering Autonomous Driving & Sensor Integration

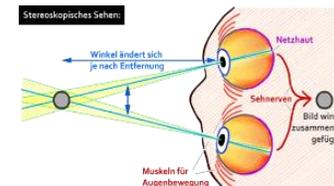
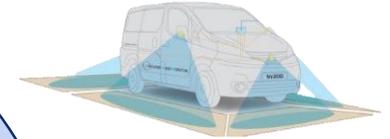
IAV – ZKW System Partner



ZKW Sensor – Building Blocks



Level 3 Democar





ZKW & LG – The Future of Light



BRIGHT MINDS,
BRIGHT LIGHTS.

**Smaller
Safer
Smarter**



Individualization



Digitization

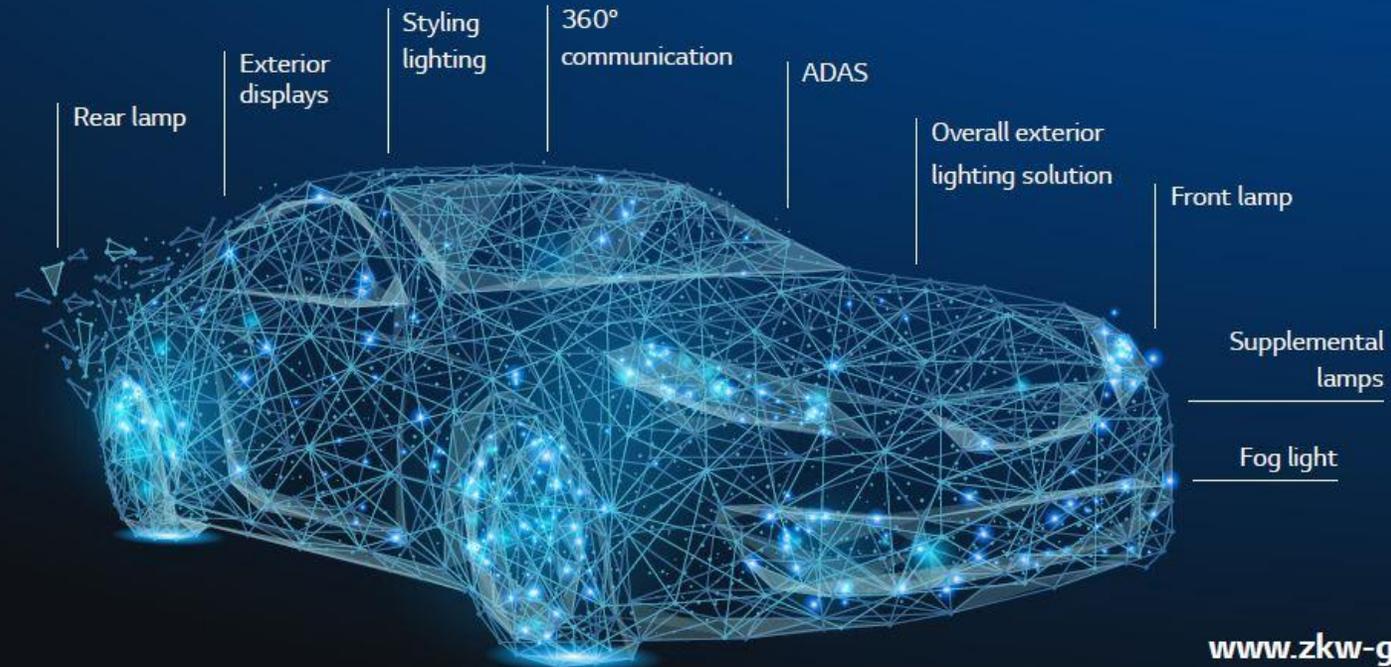


E-Mobility



Autonomous driving

THE FUTURE OF LIGHT



THE FUTURE OF LIGHT



BRIGHT MINDS,
BRIGHT LIGHTS.

THANK YOU

