

DVN Detroit Workshop Report

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TABLE OF CONTENTS

About Driving Vision News	3
Keynote Speeches	4
Roland Berger - "Trends in the automotive industry, Light at the end of the tunnel?"	4
Driving Vision News - "Lighting Trends"	6
S&P Global Mobility - "Illuminating the Future: Market Dynamics and Data Insights in Interior and Exterior Lighting"	8
Session 1 Interior Lighting	10
Antolin - "Seamless Light backlit surfaces to redefine in car interiors"	10
Forvia Hella - "Interior lighting innovation, Lighting the Cockpit of the Future"	11
Valeo - "Interior Lighting in Software Defined Vehicles"	12
Preh - "Lighting Innovation to Elevate Safety and Style"	13
Covestro - "Advanced Automotive Interior Technologies Aesthetics and Performance"	14
Raffar - "In the face of the impossible, we are inspired"	15
MD Group - "Powering Automotive Interior Lighting"	16
Inova - "An automotive ambient lighting standard"	17
PNNL - "Automobile Lighting Flicker: A Health Hazard We Can Fix"	18
Session 2 : New Technology & Approach	20
Ford - "Update from Ford 2025"	20
HUAJU OPTIC - "Innovations in the optical components of projection systems - Glass aspheric lenses"	21
Sunex - "Lens Hybridization for μ LED Headlamps, Balancing Cost, Size, and Optical Performance"	22
TechnoTeam Vision USA - "Photometric tools to help convey your message with light"	23
OLEDWorks - "Bendable OLED: Shaping New Opportunities for Automotive Lighting"	23
Sabic - "Innovative Material Development for Light Shielding, Solution for AUTOMOTIVE Headlamp Reflector Brackets"	25
Synopsis - "Modern Microstructure Design"	25
United Visual Researchers - "Streamlining Lighting Design Collaboration with Predict Suite's API"	27
Llink Technologies - "Advanced Remanufacturing for Modern Lighting: Where Innovation Meets Responsibility"	28
Magwerks - "Innovative Headlamp Optical System and Construction"	29
Brightview Technologies - "Novel Automotive Lighting Solutions Using Computational Optics"	30
DAJAC - "From Vision to Validation: One Test at a Time"	31
NanoVents - "PFAS-Free Vents Innovation: Advanced Adjustable Multilayer Nanomembrane Solutions for a Sustainable Future"	31
Session 3 : Regulation.....	33
Mercedes-Benz - "Mercedes-Benz ADS Marker Light Questionnaire and On-Road Study"	33
General Motors / SAE - "Introduction – Standards Development Program in Lighting Systems Group"	34
"Status Report of SAE J3283TM Exterior Lighting Use During the Park Condition of a Vehicle Task Force and SAE J3098TM Front Decorative Lamp"	34
Sapphire Technical Solutions (STS) - "ADB Measurement"	35
North American Lighting / SAE - "Status report SAE J3134TM Recommended Practice Automated Driving System (ADS) Marker Lamps"	37
Valeo / SAE - "SAE J3308 Driver Assistance Projections (DAP) & Signaling Road Projections (SRP) Overview & Update"	37
ams OSRAM / SAE - "GTB and GRE Update"	38
SESSION 4: EE architecture.....	40
Infineon - "How Infineon's smart LED drivers enable software-less architectures in automotive lighting"	40
Brightek - "A Smart Lighting Solution for MCU-Less Automotive Systems"	41
Analog Devices - "Evolving Architectures of Headlamps in SDV"	42
Microchip - "Lighting the Edge: Strategies in Software-Defined Vehicles"	43
ams OSRAM - "Open System Protocol drivers to bring exterior lighting to life"	43
Lumissil Microsystems - "Intelligent Signal Displays & Communication Lighting: Communicating Safety and Style Through Automotive Lighting"	44
Session 5 : Lighting and Safety	46
General Motors - "Headlamp Ratings and Optics"	46
Rivian - "Rivian ADB fist to US market"	47
Marelli - "Infrared support for future AEB systems"	47
Ansys - "Virtual Prototypes for Appearance Validation of Lighting"	49
ams OSRAM - "Freedom of choice in ADB resolution: EVIYOS Flex and the new OSLOX PX"	50
OPmobility - "FMVSS ADB"	51
Lumileds - "Customized modular solutions for full Headlighting & ADB solutions, accelerating US market adoption"	52
J.W. Speaker - "Ultra Slim μ LED Dual Matrix Module"	53
Valeo - "Near Field Projection: Enhanced Safety or a Gadget"	55
Session 6 : Car Body Lighting.....	57
Tactotek - "Slim, Smart, and Efficient: Lighting up Emblems with IMSE"	57
Luminit - "Visible Light Communication (VLC) and other Automotive Applications using Holographic Optically Illuminated Displays"	57
SL America - "Kia EV9 and Cadillac Celestiq car body lighting"	59
Magna - "Optically Efficient Hidden Until Lit Solution"	59
Swarovski - "Driving Brilliance: The Role of Crystal in Future Mobility"	61
FORVIA HELLA - "SAPHIR: Sustainable Exterior Lighting Innovations"	62
Exhibitors Innovations.....	64
Networking.....	84
List of main DVN Monthly Reports.....	88
DVN ecosystem and scientific community	89

ABOUT DRIVING VISION NEWS

DVN is the vehicle lighting: ADAS; lidar, and interior world's journal or record, dedicated to keeping the community informed and communicating about the latest progress and developments. DVN's three pillars are:

- **Technological watch** on new emerging technologies, with weekly electronic newsletters bringing news, analysis, and crucial information on innovation in lighting, ADAS, lidar, and car interior; there are also monthly technical reports with sharp focus on cutting edge technologies, company profiles, regulatory matters, and other relevant content available only from DVN.
- **Networking** of high-level decisionmakers, researchers, innovators, practitioners, academics, and regulators to make new business connections with two workshops per year in rotating locations throughout America; Europe; China; Japan; India, and Korea. DVN Workshops are very popular, and routinely fill to capacity with over 350 participants.
- **Promotion of innovations** - we facilitate the promulgation of knowledge of innovation, which in turn paves the way for commercialization, enabling to build new relationships through DVN Community to forge new business worldwide, The DVN Gold membership roster includes 260 companies including automakers; lighting and ADAS tier-1 and -2 suppliers, and a wide variety of universities; research outfits, and consultants. DVN Gold members receive all publications and attendance privileges at all DVN Workshops.

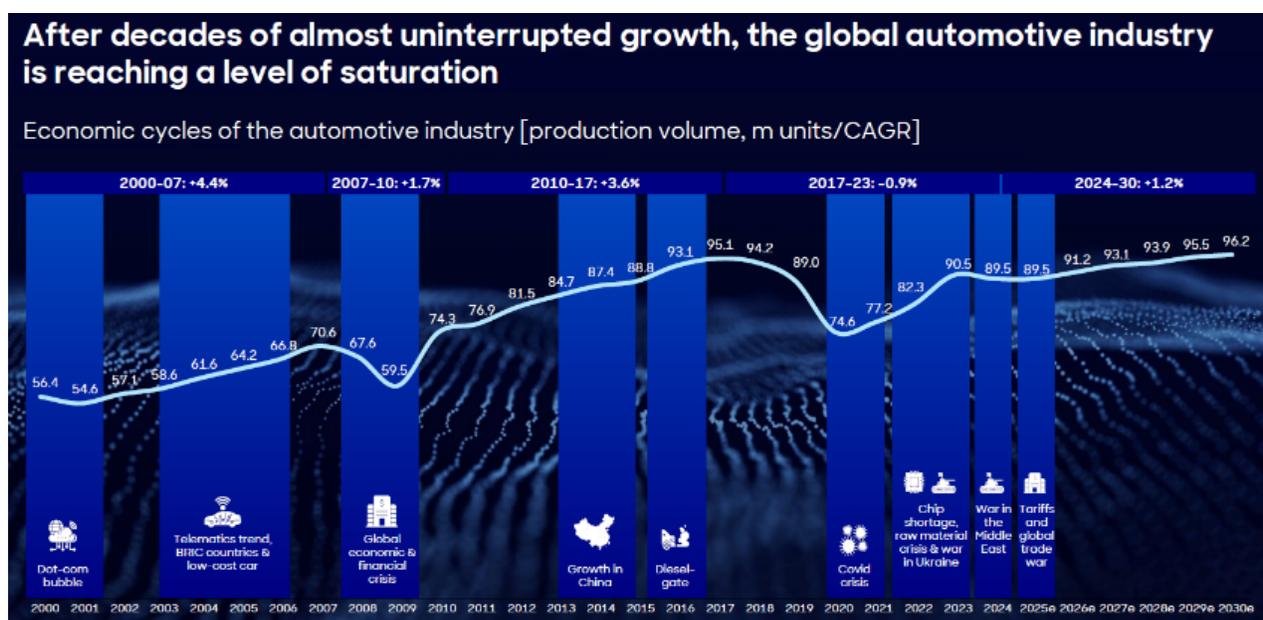
KEYNOTE SPEECHES

Roland Berger - “Trends in the automotive industry, Light at the end of the tunnel?”

Falk Meissner

Falk Meissner of Roland Berger delivered an engaging and forward looking talk that framed automotive lighting and HMI not as isolated technologies, but as the backbone of future mobility. “We’ve moved far beyond styling and safety,” he began. “Lighting is now a platform, integrating sensors, enabling ADAS, and shaping how drivers experience and trust their vehicles.”

Meissner reminded the audience how quickly the industry has shifted and the challenges that the automotive industry has faced. Companies are focused on efficiency with the expense of innovation, leading to periods of stagnation. Additionally, China’s growth and shift has been felt



across the industry, reshaping both competition and collaboration.

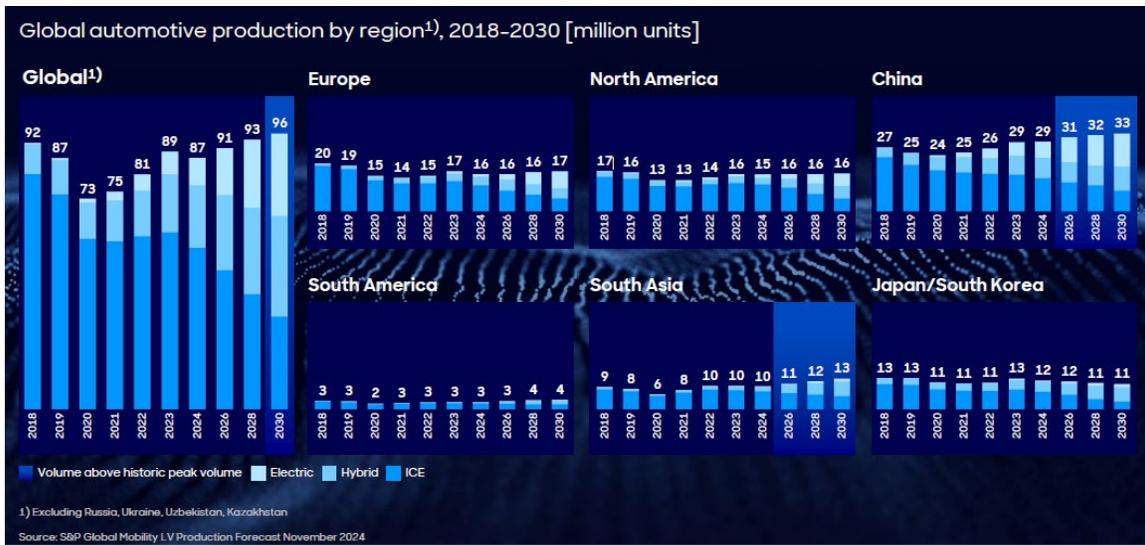
Source: S&P Global Mobility

Volumes have recovered rapidly after Covid, additionally we have conquered semiconductor shortage challenges, however the market now seems saturated, and volumes are flattening causing the industry to change strategy from growth back to cost efficiency operations.

Global uncertainty has further affected the industry, and particularly in the US is adding to the challenge. Tariff policies, introduced only 7 months ago, have delayed decision making on long-term contracts and continue to shift manufacturing locations. This uncertainty has slowed technology adoption, with EV penetration continuing more cautiously than anticipated, as charging infrastructure struggles to keep pace and incentives are being withdrawn.

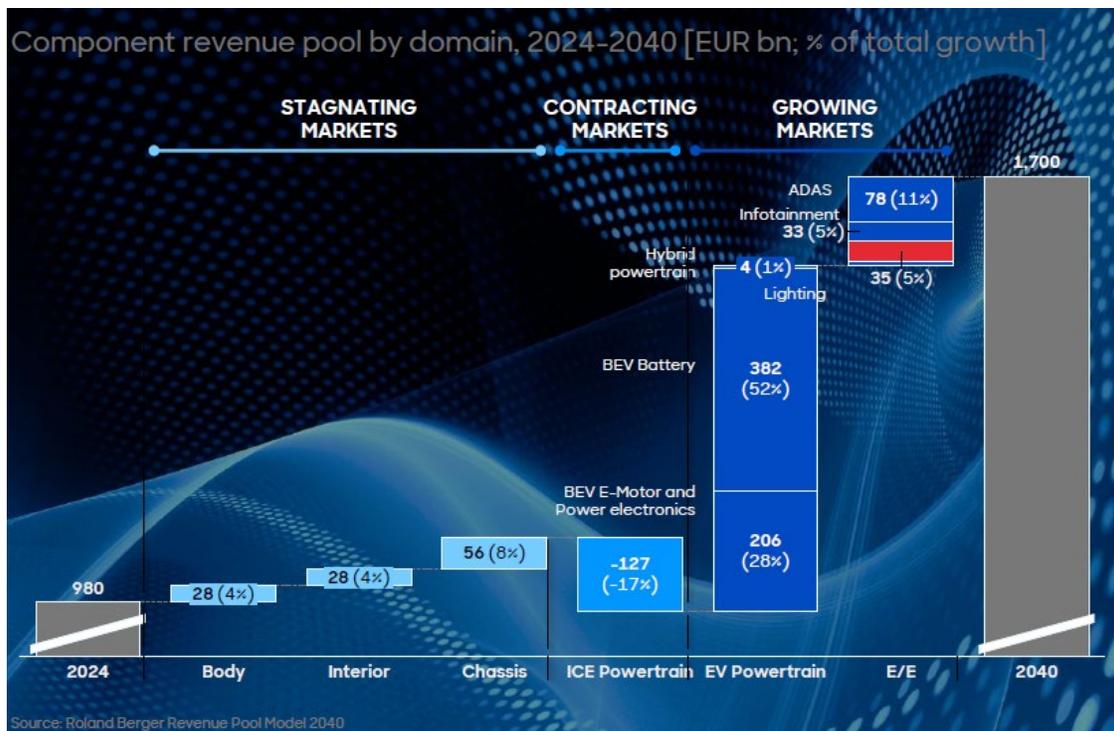
ADAS technology adoption has slowed down as well but gained extra impulse by autonomous self-driving ventures. A great topic is the Software defined vehicles adoption that was underestimated by traditional OEMs due cost and challenges reflected a slow down of this technology adoption.

The question is if this will lead to a decoupling of technology between China, Europe and the US, where this last one will stay behind the rest of the world.



Looking at the future, global volumes are predicted to return to pre-Covid peak of 95 million around 2030, however growth is happening in China and Southeast Asia.

China is moving rapidly because its younger generation is less hesitant to adopt technologies and less bound by preconceptions of how a car must look and behave. This openness has allowed new technology players in the automotive industry to come from consumer electronics manufacturers. By contrast, global OEMs are falling behind since they can not keep up with the innovation drive and quality of features coming out of the Chinese ecosystem, pushing many of them to fall back on cost reduction as survival strategy. This additional stress has made OEMs and Suppliers to rethink how they operate, leading to partnerships to gain scale or technology access.



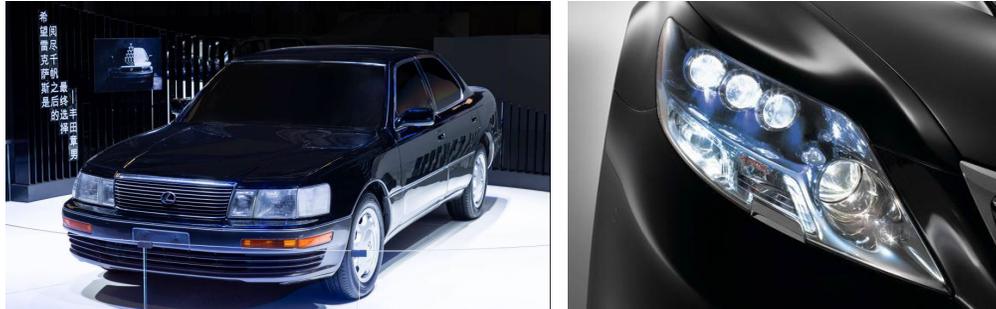
A positive outlook for lighting is ahead with 5% of growth until 2030 from border content uplift per vehicle as migration to LED as well as ADB adoption coupled with full width light bars that are animated for DRL and Turn, branded signatures, rapid adoption of rear OLED as well as increased integration into SDV.

Driving Vision News - “Lighting Trends”

Paul-Henri Matha

Paul presentation toured how automakers are increasingly using lighting technology as a central element of vehicle design and brand communication and how this is shifting dynamics affecting technology adoption, market growth, and competitive positioning among OEMs and suppliers.

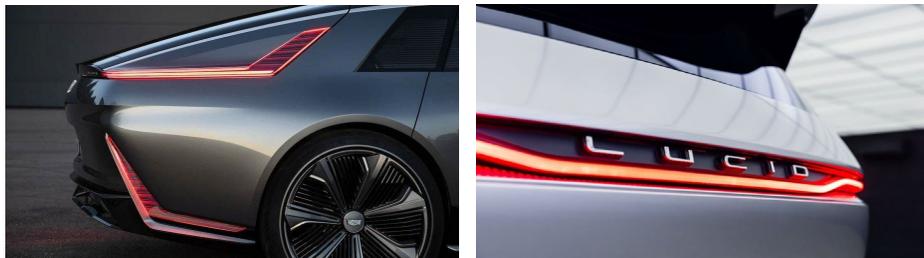
The conversation began with an overview of how automotive lighting has rapidly evolved, moving from traditional bulbs to LEDs in just 20 years. The first LED Low Beam in Japan in 2007 on Lexus LS600, making a key milestone. Since then, the industry has progressed from no electronics at all to digital embedded display technology. This has transformed the required skillsets shifting from a primarily opto-mechanical engineering discipline to an increasingly centered on electronics and software integration.



As we look at current trends that have been enabled by technology, complex lighting shapes are becoming a reality. This is evident in Shanghai, the US and Europe, where complex shapes in the front and rear extend across the full vehicle width.

Lighting has also expanded into the grill, or lack of it on EV vehicles, to the front panel, with long molded pieces up to two meters in length, leveraging molding processes traditionally used for bumpers. These advances require updates to supporting systems such as goniometers to accommodate new geometries and are typical challenges in the industry.

Another strong global trend is the rise of illuminated logos, which highlights the DNA of the lamp and serve as a dynamic marketing tool through creative activation sequences.



Heritage remains central focus for certain brands such as Bentley and Nissan, where lighting design reinforces their identity. At the same time, pixelated lighting is gaining a lot of traction, enabling the end user for customization to create unique signature lights. Pixel applications also allow the integration of symbols, which add both aesthetic appeal and functionality.



In Japan, V2X projection lighting is emerging as a way to communicate with the environment, using RGB LEDs for welcome animations, charging indicators and branding opportunities. Lighting is also being explored for gaming and film projection onto the ground, expanding its role beyond only vehicle safety.



Regulations need to be considered, such is the case of the 75 mm lit logo rule integrated into headlamps, with nearly 50% of the European vehicles now featuring illuminated logos on front and rear. Films are increasingly being combined with lenses to create differentiation, while Mercedes Benz GLC highlighted in IAA how an illuminated grille and MB star can anchor a full marketing strategy.

Other regional examples to reinforce lighting shifts can be seen in Chengdu Auto Show where turquoise lighting is used throughout vehicles to indicate autonomous driving mode or in Monterey Car week in the US where Cadillac concept showcased vertical central light elements. Faraday Future and Tenso (China) showcased customizable display-based lighting systems.



Overall, lighting continues to evolve as both a branding tool and a communication platform where blending heritage is mixed with technology to define the future of car identity.

These current trends face technical challenges since they must be executed in simpler, more cost effective, repairable and updatable ways. To address this, the industry is developing solutions such as film-based systems and phantom laser technologies, which improve light homogeneity while reducing complexity.

Repairability has also emerged as a key trend. For example, the Renault 4 concept allows not only lamp replacement but also full grill replacement if necessary. Similarly, Valeo, in partnership with Stellantis in Europe, has introduced initiatives focused on lamp repairability to reduce costs and support sustainability.



At the same time, software is becoming central to lamp functionality. With over the air updates, lighting can deliver new features and themes, such as Rivian's seasonal "Halloween" mode in the US, unlike Europe where certification requirements impose stricter controls, US regulations currently allow these creative updates without additional approval.

S&P Global Mobility - “Illuminating the Future: Market Dynamics and Data Insights in Interior and Exterior Lighting”

Tanya Chantiri

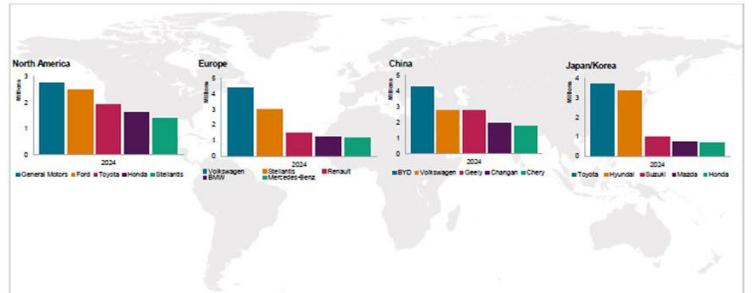
S&P Global Mobility outlined the intersection of supply chain, technology, and lighting trends, supported by a global network of over 90 analysts tracking 300+ technologies, 5,000+ suppliers, and 30 million data rows updated monthly. The service provides insights for forecasting new developments, benchmarking competitors, and understanding OEM purchasing strategies.

The global light vehicle production outlook projects 90.4 million units in 2025, a modest 1% growth, with North America down -3.3% year-over-year. Trade policies are reshaping imports into the U.S., with tariffs on non-USMCA compliant parts reaching 25% until 2027.

Global Light Vehicle Production



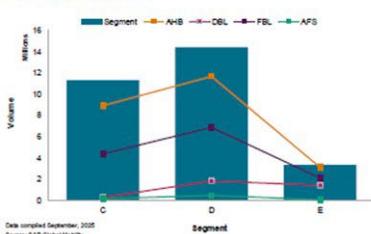
Data compiled August, 2025
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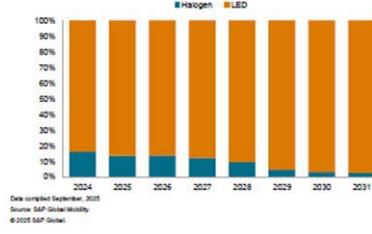
Electrification and autonomy trends show short-term boosts in China from trade-in incentives, while EU policy shifts could temporarily sustain ICE volumes. In the U.S., political uncertainty is delaying BEV launches. Globally, adoption of autonomy above Level 2+ remains limited over the next decade.

Headlamp Dynamic Functions by Segment in 2024



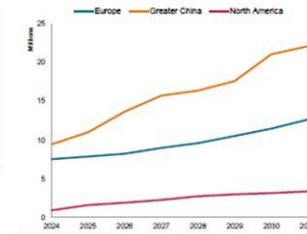
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Headlamp High Beam Type



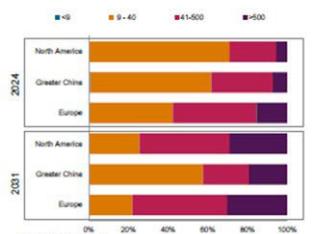
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Headlamp ADB Function by Region



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Headlamp ADB Pixel Segment 2024 vs 2031

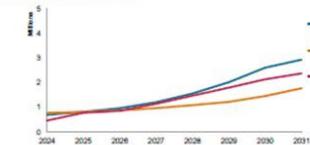


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In front lighting, halogen continues its decline, with LEDs dominating. AHB is the most common dynamic function, present in 85% of vehicles. While Europe and China move toward advanced pixel ADB systems, North America shows slower uptake, with German exports driving most adoption. Grille illumination, light bars, and illuminated logos are rising trends, especially among EVs.

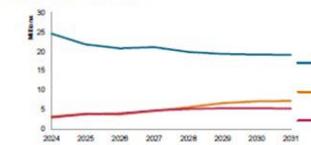
Rear lighting is also shifting, as LEDs replace halogen and combination lamps. Dynamic LEDs and OLEDs are gaining presence, while split and bar-type tail lamps are becoming more common.

Front Illumination Type



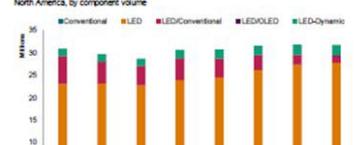
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DRL Position



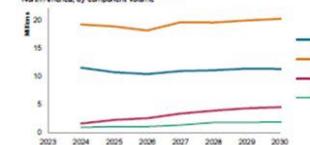
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Tail Lamp by Light Source Type



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Tail Lamp and Rear Lamp Module Type



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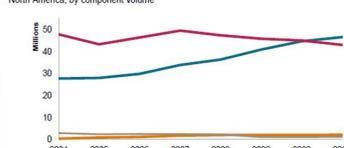
For interior ambient lighting, OEMs are leveraging LEDs, light pipes, and guides for hidden-till-lit and backlit designs. Ambient lighting now supports ADAS features and HMI, enhancing personalization and luxury. Smart functions are increasingly adopted across regions including China, Europe, and North America.

Ambient Lighting Position in North America 2024



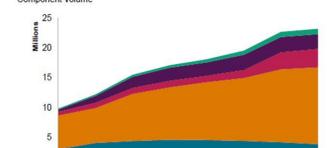
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Ambient Lighting Optical Technology



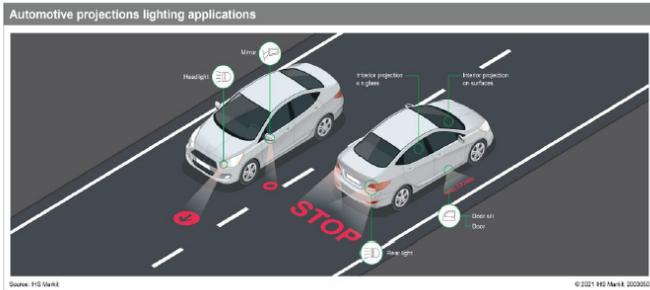
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Smart Function in Ambient Lighting by Region

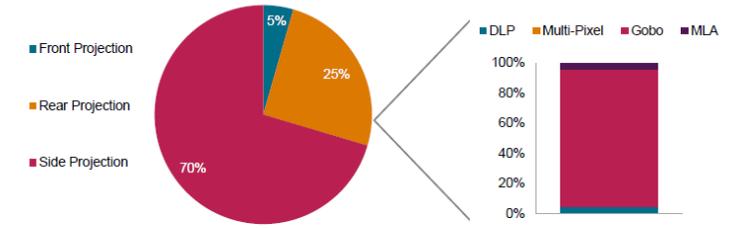


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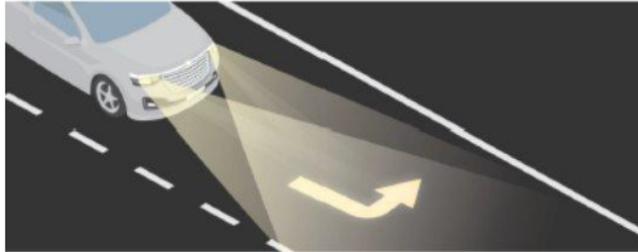
Finally, projection lighting was highlighted as an emerging technology. Advanced optics project dynamic and adaptive patterns onto the road, with fitment varying by region, front projection



Projection Lighting Fitment & Technology in North America 2024

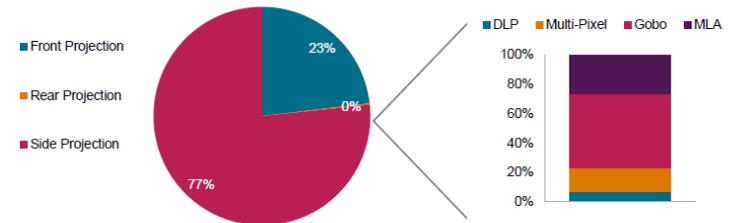


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Source: S&P Global Mobility

Projection Lighting Fitment & Technology in Europe & China 2024



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dominates in North America, while Europe and China show higher diversity across front, rear, and side applications.

In summary, S&P Global emphasized that lighting technologies are advancing from safety-driven functions toward brand identity, personalization, and interactive communication, supported by robust global data insights and forecasting capabilities.

SESSION 1 INTERIOR LIGHTING

Antolin - “Seamless Light backlit surfaces to redefine in car interiors”

Javier Cuadrado

Grupo Antolin is forecasting redefinition of the future of automotive interiors bringing together expertise in optics, electronics, coverings, and system integration. The company’s vision is to transform trim components into seamless illuminated surfaces that elevate both user experience and design freedom.

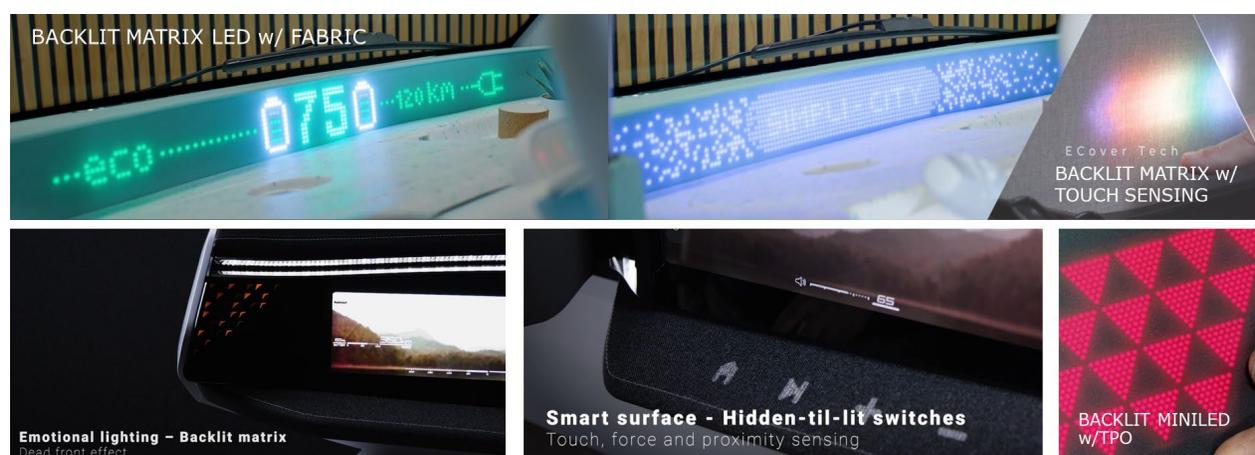
Technology has evolved significantly in the last years but is expected to continue to shift. Lighting is already on the road in many production vehicles such as backlit edge lite slim designs that are integrated into models like Cupra Terramar, Polestar 4, Zeekd 001, Alfa Romeo Tonale, HiPhi Z, and Lotus Eletre. These examples showcase how light can be harmonized with perforated vinyl, knitted fabrics, suede and hard decorative elements, providing scalability across materials and brands.



Antolin presented their backlit technology roadmap that spans from proven edge-lit modules to advanced matrix systems. Conventional and slim edge-lit solutions provide ambient integration, while backlit modules, matrix LEDs, and miniLEDs deliver higher resolution and dynamic effects. Touch-sensing matrix surfaces enable smart and interactive panels, and 2D matrix lighting opens possibilities for static, dynamic, and high-resolution options.

	BACKLIT CONVENTIONAL EDGE LIT	BACKLIT SLIM EDGE LIT	BACKLIT MODULE LED	BACKLIT MATRIX LED w/ Flexible PCBA	BACKLIT MATRIX IME IME Direct	BACKLIT MATRIX miniLED On Top Surface (Digital Lighting)
SCHEME						
COMPATIBLE WITH ALL COVERINGS?	YES	NO <i>Limited to Covering with Soft</i>	YES	YES	YES	<i>In Evaluation</i>
LIGHTING EFFECT	1D 	1D 	0D Static 	2D Matrix - Low Resolution 	2D Matrix - Low Resolution 	2D Matrix - High Resolution
GEOMETRY OF LIGHTED SURFACE	3D	3D	3D	2.5D 3D with limitations	3D	2.5D
VISIBLE during DAYTIME / FUNCTIONAL LIGHTING <small>*For covering with Light Transmission less than 60%</small>	NO	NO	NO	YES	<i>In Evaluation</i>	YES
PACKAGING LIGHT ENGINE (w/o covering)	10 mm	5mm	10mm	10mm	7mm	5mm
LUMINANCE LIGHT ENGINE (before covering)	100-200 cd/sqm	100-200 cd/sqm	50-100 cd/sqm	5000-10000cd/sqm	5000cd/sqm	>10000cd/sqm
MATURE OF TECHNOLOGY	<i>Ready for RFQ</i>	<i>Ready for RFQ</i>	<i>Ready for RFQ</i>	<i>Ready for RFQ</i>	<i>Technical Feasibility: OK</i> <i>Industrial Feasibility: In progress</i>	<i>Technical Feasibility: In progress</i> <i>Industrial Feasibility: In progress</i>

A key differentiator is Antolin’s deep knowledge of coverings and finishes. Lighting can be embedded into soft materials like leather, fabrics, or spacer knits, as well as hard surfaces such as IMF or painted panels. The company is also advancing sustainable solutions with Persiskin, recycled PES, and monomaterials, aligning innovation with environmental goals.



Looking ahead, Antolin is pushing toward immersive and phygital experiences, the fusion of physical materials with digital light and sensing. Innovations include matrix LEDs combined with fabrics or TPO, miniLEDs with touch-enabled smart surfaces, and 3D illumination concepts integrating stone, cork, and sustainable elements. A new design language is emerging,

summarized as “*Shadow is the new glow*”, where precision optics create light-shadow effects with depth and visual richness.



Grupo Antolin’s roadmap illustrates a clear commitment to deliver seamless, sustainable, and intelligent backlit surfaces that redefine interior ambiance and interaction. By merging material craftsmanship with advanced lighting and sensing, Antolin is enabling OEMs to transform interiors into functional, emotional, and highly distinctive experiences.

Forvia Hella - “Interior lighting innovation, Lighting the Cockpit of the Future”

Eoin Ryan

Forvia-Hella presented their vision of how interior lighting innovations will transform the cockpit into a functional, emotional, and intelligent space by leveraging its global portfolio of R&D centers and industrial sites, Hella is developing a wide range of technologies that blend lighting, sensing and design to elevate the user experience.

A cornerstone of this strategy is the COFI family, a slim surface backlighting system offering large-area illumination with weight reduction and anti-buzz/squeak/rattle performance. Variants include static and dynamic lighting scenarios, animated backlighting, and cost-efficient solutions, with several concepts already moving into pre-development or series readiness.



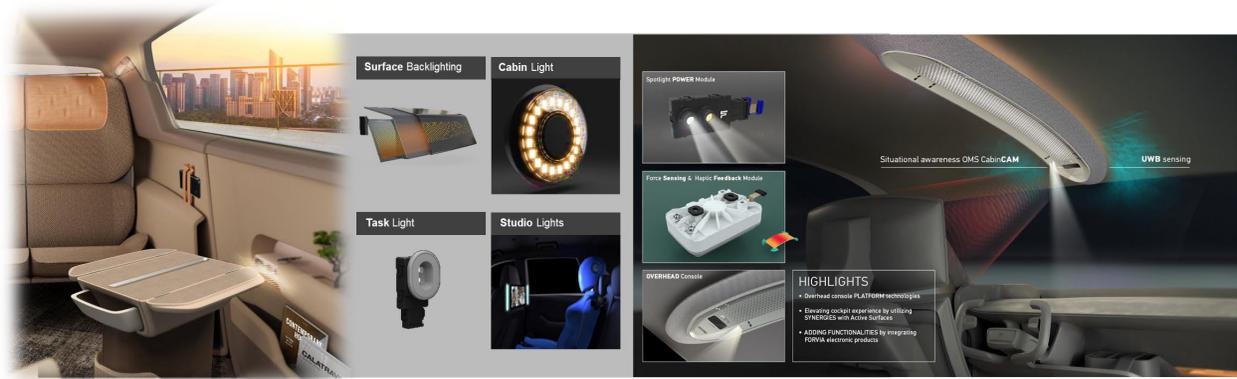
Beyond backlighting, Forvia Hella introduced CoraLight, a next-generation smart lighting platform. Using advanced sensing foil technology, miniaturized LEDs, and PUR lens protection, CoraLight enables high design flexibility, modular integration, and strong light values. It supports multiple animations, day and night modes, and can serve as both a design element and part of the vehicle’s information or warning system.

Hella highlighted incident light projection, which enriches surfaces through semi-dynamic light patterns. These effects combine ambiance with functional information and sensing, offering both cost-effectiveness and design personalization.



Under the theme Premium by Light, Forvia Hella demonstrated how tunable white light, high CRI, and precise beam control contribute to an elevated in-cabin experience. Applications span immersive ambient effects, task lighting, cabin lighting with CRI 90+ for video or well-being, and compact studio lights for flexible cockpit use.

Finally, the company emphasized the emotional dimension of interior lighting. Using customized lighting scenarios, vehicle interiors influence driving pleasure specially in long trips, bring family together, and facilitate getting in and out of the vehicle, turning light into a key element for mobility.

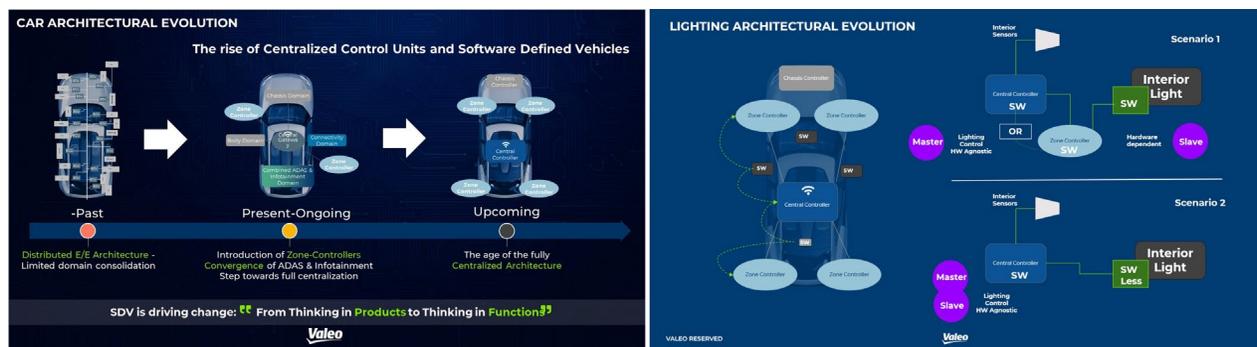


Forvia-Hella’s roadmap places lighting as more than an aesthetic element, it is becoming a multifunctional interface that merges design, comfort, and communication, shaping the cockpit of the future into a personalized and connected environment.

Valeo - “Interior Lighting in Software Defined Vehicles” **Kumail Syed**

Valeo presented how interior lighting is evolving in the context of software defined vehicles. The company highlighted worldwide trends between 2025 and 2035, where design and experience, safety and usability, and sustainability and virtualization are driving change. Lighting will need to be contouring, intuitive, utilitarian, sustainable, and virtualized, as seen in approaches from OEMs.

Valeo illustrated car architectural evolution, starting from distributed E/E architectures with limited domain consolidation, moving to zone controllers that combine ADAS and infotainment, and ultimately toward the age of the fully centralized architecture. The rise of centralized control units is shifting development from thinking in products to thinking in functions.



A similar transformation is underway in lighting architectural evolution, where master hardware-dependent systems are giving way to software-driven approaches. Scenarios showed how software can decouple lighting control from specific hardware, allowing zone and central controllers to manage functions, integrate sensors, and remain hardware agnostic.

Valeo described its current capability, ranging from domain controller level down to smart component level. The lighting stack includes application state machines for activation, arbitration, and synchronization, as well as board services, data pipelines, algorithm utilities, and integration of RGB modules, projection, and beam management. Benchmarks showed high performance in signaling and animation, enabling lane pictograms, ADB/AFS, and HD screen renderings.



The product portfolio presented includes dynamic ambient lighting with rSmart LEDs and electronics, static ambient lines using RGB modules and light guides, 2D backlit systems, pixelated reading lamps, backlit surfaces, and projection modules. Software libraries and

digital/virtualization tools support unique lighting signatures, brand identity, and personalization. Examples were shown with Volkswagen, Zeekr, and Lynk&Co.



The presentation concluded with Valeo’s approach to lighting in software defined vehicles, where software is optimized to hardware today but is moving toward software fully decoupled from hardware. Using Valeo Core Software (V-Core) and integration and test services, this enables an extended lifecycle for interior lighting systems. The message closed with the statement: “The future is here.”

Preh - “Lighting Innovation to Elevate Safety and Style”

Luis Hernandez

Preh introduced its vision of how lighting innovation can enhance both safety and style in the vehicle interior. Preh has a history of over 100 years and has served as an HMI specialist for almost half, the company has delivered numerous brake through concepts for premium brands.

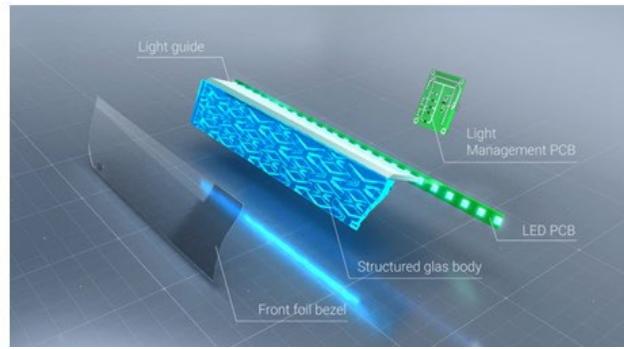
Preh began with today’s role of ambient lighting that goes beyond aesthetics, it improves comfort and safety. Ambient lighting improves cabin atmosphere and comfort, increases visibility in the environment, and allows customization through adjustable color, brightness, and dynamics. It also reduces eye strain, helps maintain concentration, and serves simultaneously as functional and decorative illumination.



Preh also showcased 3D advanced lighting and functional safety concepts, where discrete LEDs behind masking, matrix LEDs, and integrated electronics create depth effects that add a new dimension to driver communication. These 3D light signals additional support to functional safety by delivering alerts for lane departure or other messages; while the system can also integrate HMI features such as touch, force, haptic feedback, proximity sensing, and 3D gestures.



The Advanced Light Concept uses these building blocks with LEDs, PCBs, ECUs, light guides, and bus system integration and synchronizes lighting throughout the interior of the vehicle. The system is designed to meet functional safety up to ASIL D, ensuring reliability for critical alerts in increasingly automated driving modes.



Preh’s approach shows how ambient and 3D advanced lighting can transform vehicle safety from passive awareness to proactive communication. Ambient lighting enhances passenger comfort, while 3D effects add clarity and depth to driver alerts. By merging design with safety and integrating intuitive HMI technologies, Preh positions lighting as both a style element and a critical tool for intelligent interaction in future vehicles.

Covestro - “Advanced Automotive Interior Technologies Aesthetics and Performance”

Mark Torgerson

Covestro stated with highlighting the importance of providing designers access to optical data and materials early in the digital design process. By making a portfolio of mainly neutral grays and diffusion colors available, designers can begin modeling and avoiding LED hotspots even before physical samples are required.

Standard Portfolio – Neutral Density Colors

Color no.	755305	755315	755325	755335	755345	755355	755365	755375
1 mm	32	48	57	65	71	76	80	84
2 mm	12	27	38	47	56	64	72	79
3 mm	5	15	25	35	45	55	65	75
4 mm	2	8	16	25	36	47	58	70

Transmission (Ty) according to ISO11694-3 [%]

Standard Portfolio – Diffusive Colors

Final Color:	028305	028315	028325	028335	028345	028355
2 mm	86.6	86.0	84.7	77.5	65.9	53.4
3 mm	86.0	84.3	80.6	68.3	54.6	46.3
4 mm	85.4	82.7	75.5	60.2	46.8	40.4

Final Color:	028305	028315	028325	028335	028345	028355
2 mm	2.4	10.7	19.7	26.1	33.0	54.5
3 mm	5	15	25	35	45	55
4 mm	9.3	20.2	30.2	38.9	49.7	57.1

Color:	720005	720014	19F316MA
2 mm	79%	21%	66%

Half power angle (HPA) according to Covestro Test [°]

Transmission (Ty) according to ISO11694-3 [%]

Disclaimer: The absolute values or spectral curves of the color measurement given above do not imply a specification but represent a single measurement result. Test values can vary between laboratories due to influences from handling, processing, equipment and/or storage conditions.

Covestro highlighted the typical process when new colors are requested, integrators can mix them, although in that case the optical data follows afterward, most likely after design and color matching has concluded. To improve this, Covestro has created a database that includes material optical data for color selection that can be used for simulation purposes. All datasets are accessible through the company’s website and can be uploaded directly into modeling tools. Access must be requested and approved through the site or directly at a company’s representative.

Covestro’s Imagio Color Database

On-line optical data for color selection and simulation

Covestro’s Imagio Color Database

On-line optical data for color selection and simulation

With this tool, digital design of colors samples can be prepared to visualize appearance before physical production. This underlines a growing move into digital-first workflows.

Another key highlight was the higher efficiency black taillight. The challenge of delivering blacked taillights without excessive heat sinks or high LED power consumption is addressed with options that allow more light output while retaining the black appearance.

In conclusion, Covestro showed how digital design tools, advanced materials, and optical innovations are shaping a more efficient, realistic, and sustainable path for automotive lighting.

Raffar - “In the face of the impossible, we are inspired”

Liam Lin and Mario Lin

Raffar Technology introduced its role as a total solution provider for automotive ICs with a global footprint and a strong patent base in the U.S., Taiwan, and China. Established in 2009 and headquartered in Zhubei City, Hsinchu, Taiwan, the company also operates branches in Michigan, Stuttgart, Turin, and Shenzhen. Its certified supply chain spans foundries in Taiwan, Korea, Japan, and China, and assembly houses across Taiwan, China, and Malaysia.

The company highlighted its product applications, particularly the RT5648Q for automotive matrix displays and rear lights, and the RT7216NQ for interior ambient and functional lighting.

RT7216NQ

- Interior Ambient Lighting
- Functional Lighting



RT5648Q

- Automotive Matrix Display
- Automotive Rear Light

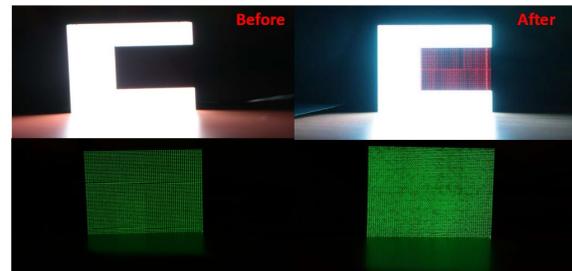
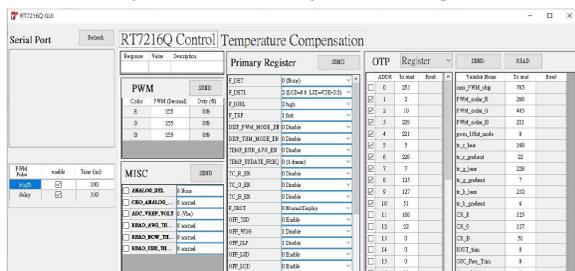


A key focus was on the RT7216NQ dot & line ambient light driver, which features three RGB channels with separate temperature compensation, high power (60mA per channel), open/short and over-temperature protection, CRC-protected serial communication, ultra-low standby current, and watchdog protection. The RT7216NQ also improves accuracy of white balance by storing LED color calibration data. Raffar’s development GUI tools enable easy modification of register commands and support LED color/intensity adjustments in CIE space.

Raffar then presented the RT5648Q Automotive ISD (Interactive/Intelligent Signal Display). Key features include dual display modes (video for faster data upgrades, photo for reduced MCU loading), adjustable PWM frequency, high refresh mode, enhanced brightness efficiency, multiple layout modes, internal clock generator, and low grayscale compensation.

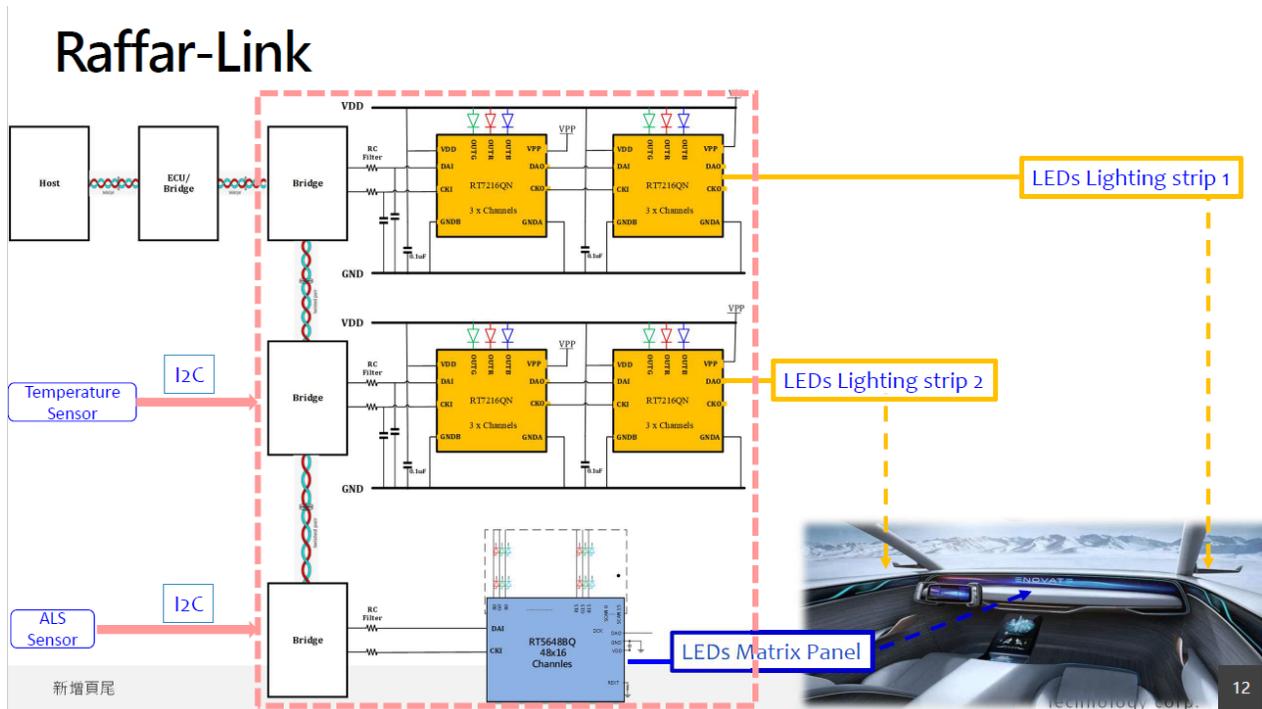
RT5648Q

Raffar Development GUI – 1. Easily Modified Register Command • Low Grayscale Compensation



Raffar showed the before-and-after performance of the RT5648Q and its capability to control large LED arrays using time-multiplexing, dual voltage supply, and high-speed SPI/CAN-like interfaces.

Finally, the Raffar-Link system was introduced, combining LED strips, matrix panels, ALS and temperature sensors through I²C communication for integrated lighting solutions.



In summary, Raffar showed how its ICs, drivers, and system tools support optimized automotive ambient and signal lighting, enabling higher performance, safer operation, and flexible design integration.

MD Group - “Powering Automotive Interior Lighting”

Bruno Machado

MD Group introduced their capabilities for global engineering solutions provider, established in 1989 with headquarters in Portugal and facilities in Mexico and China, the company delivers high-precision manufacturing solutions for automotive and continues to invest in supporting strategic partners.

The company has global manufacturing locations in Portugal, Mexico, and China, totaling over 29,000 sqm and employing nearly 900 employees and has cross functional capabilities for ambient lighting development, managing every step from concept design and validation through tooling, process development, engineering, prototyping, and final production, ensuring faster time to market and world-class production quality.

In terms of innovation for performance, the company develops lighting solutions with outstanding optical results. Features include light guides up to 1,500 mm in length, milling radii below 0.05 mm, surface roughness under 20 nanometers, and exceptional homogeneity.

MD introduced the concept that “Lighting is the New Chrome,” underscoring its role in system integration. The company co-develops lighting integration into subsystems by collaborating with electronic partners for light sources, module design and delivery, and with coating experts like Kurz for concept, process, and foil production.



Strategic Partnerships for Integrated Solutions

MD GROUP.



Electronics

In summary, MD Group showed how its global footprint, integrated development process, advanced manufacturing precision, and strategic partnerships position it as a Tier 1.5 partner delivering innovative interior lighting solutions to the automotive industry.

Inova - "An automotive ambient lighting standard"

Gerhard Nill

Inova focused on the ISELED and ILaS smart LED technologies, which integrate RGB LEDs with driver and controller ICs to minimize external components and system costs. These smart LEDs come manufacturer-calibrated, avoiding costly in-system calibration at Tier 1 and reducing the need for compensation algorithms on the central MCU. Daisy-chaining of up to 4,079 LEDs with auto-addressing and group or broadcast addresses enables scalable solutions.



ISELED and ILaS adapt to all E/E architectures, whether distributed, centralized, or zonal. Lighting data can be streamed over Ethernet to ILaS, with precision time protocol allowing synchronization and updates on the fly.

The portfolio of network and lighting products includes calibrated ISELED smart RGB LEDs from multiple suppliers such as Brightek, Dominant, Everlight, Harvatek, Lextar, and Liteon, as well as ILaS smart RGB LEDs and tunable white LEDs. Drivers such as the INLT301Q support 16-bit PWM resolution, color control, temperature compensation, cable interfaces, and integrated DC/DC converters, all optimized for EMI/EMC and automotive robustness.



The roadmap includes ISELED 2.0, a next-generation driver offering improved current control, automatic temperature compensation, daytime and nighttime calibration sets, and full compatibility with

The standard is already proven in production with models such as the Kia Carnival (2021), Hyundai Grandeur (2022), Honqi H9 (2020), Zeekr 001 (2021), Leapmotor C01 (2022), Lotus Eletre (2023), Lotus Emeya (2024), and NIO ET9 (2025). The BMW Group has adopted ISELED widely across series including the i7, XM, 5 Series, X3/X4, X5/X6/X7, Mini Cooper/Aceman, and 2 Series.

The ISELED Light & Sensor Network extends into zonal architectures, integrating ambient and functional lighting with sensors and actuators on a single virtual bus. This simplifies E/E network integration through 10BASE-T1S bridges, supports plug-and-play light sources, and enables diagnostics and auto-compensation.

Key benefits include reduced cost with more features, simplified software management, easy OTA updates, lighting as a service, reduced bill of materials, integrated DC/DC control, sensor integration, and a robust ecosystem of suppliers that mitigates supply chain risks.

In summary, Inova positioned ISELED and ILaS as the foundation of a new standard for automotive ambient lighting, combining scalability, cost efficiency, diagnostics, and compatibility with future SDV architectures.

PNNL - “Automobile Lighting Flicker: A Health Hazard We Can Fix”

Naomi J Miller

Naomi Miller urged the automotive industry to address flicker in vehicle lighting electronics. Flicker, or temporal light modulation (TLM), is linked to numerous health and comfort issues. Observers can experience headaches, migraines, seizures (at 3–65 Hz), slowed reading and comprehension, distraction, nausea, and disorientation. Results from a 2024 PNNL flicker experiment showed that about 26% of participants had adverse reactions to the phantom array effect (adjusted for migraine prevalence), while 45% reported being bothered by flicker.

She explained that typical TLM in automobiles uses 200 Hz frequency, ~8% duty cycle, and 100% PWM modulation, conditions that are very annoying and disruptive. By contrast, improved TLM at 20,000+ Hz with a 0.08% duty cycle can eliminate the problem.

The Phantom Array Effect is a form of flicker (TLM) prominent when PWM is used to dim LEDs

Observer's eyes scanning (i.e., a visual saccade) from left target to light source

Guess what? Screens can flicker, too. And cameras can make flickering surfaces and lights look *really* weird.

My phone is making me sick and I'm not alone

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It all began one day when I was playing Fortnite with my wife and my son. I was using a Samsung Galaxy Z Fold 4 with my favorite mobile controller — the GameSir X2 — and noticed my eyes ached after playing for an hour or so. That just turned 37 two months prior and knew that as I got closer to that magical age of 40, things like this would just start happening.

Miller demonstrated the phantom array effect, which occurs when an observer's eyes scan across a flickering light. This creates the perception of motion and distorted positioning of the light source, potentially contributing to nausea and discomfort.

Slo-motion video examples illustrated how this issue appears in practice: first with common exterior lights (200 Hz, 100% modulation, ~8% duty cycle), and then with interior decorative lights under the same conditions. Both clearly showed disturbing flicker patterns when recorded at 240 fps.

She also reminded the audience that screens can flicker too, and that cameras can amplify the effect, making surfaces and lights appear distorted.



In conclusion, Miller stressed that flicker is a fixable hazard. By adopting higher frequency modulation strategies, automakers can significantly improve driver and passenger well-being, eliminate phantom array distortions, and avoid adverse health outcomes.

SESSION 2 : NEW TECHNOLOGY & APPROACH

Ford - "Update from Ford 2025"

Michael VanBelle

Michael gave us an update on how Ford is creating a universal vehicle as he called "a model T moment". This new universal vehicle is aimed to be affordable, flexible, EV platform, modern, electrical architecture, software defined, fun to drive, with world class lighting. Michael reiterated Ford's commitment to do business in America and compete worldwide.

Ford announced their new Product Development Center opening in fall 2025.

Ford will cultivate a culture of Engineering Excellence with focus to be leaders in Quality. To achieve this Ford is aiming to be global experts in exterior lighting utilizing technical data driven analysis, design reviews, engineering principles, disciplined problem solving, and Signoff corroboration.

They prioritize partnerships with people that share these values. He reiterated Ford's commitment to DVN, SAE, GTB, and USCAR in supporting industry standards for ADB, AEB, and other Lighting Topics.

Ford invited the audience to review their display vehicles that were a 2025MY Ford Expedition and a 2025MY Lincoln Navigator.

Michael's closing happened with a warm "Thank you" to all the people that has supported Ford.



HUAJU OPTIC - “Innovations in the optical components of projection systems - Glass aspheric lenses”

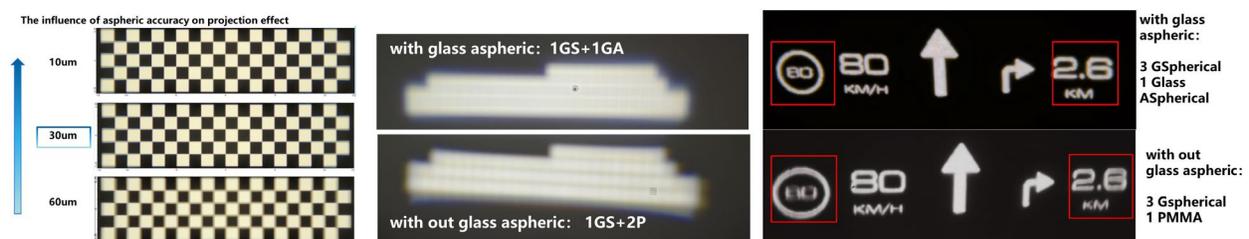
Alex Jia

Alex started highlighting the transformation of vehicle headlight projection systems in the era of intelligent mobility. Lighting has evolved from basic illumination to systems that support information interaction and smart projection, including adaptive headlights, intelligent pixel headlights, and the use of colored light projection. These functions not only improve driving safety by enhancing environmental perception and reducing risks, but also enrich the driving experience through scenario interaction, technology sensation, and brand differentiation.



The second section addressed optical design for projection systems, comparing solutions for MicroLED and DLP projectors. Various configurations such as HD-2G2P, HD-3G1P, HD-1G2P, and DLP-5G were introduced, showing how optical layouts influence performance in automotive projection applications.

The focus then shifted to glass aspheric lenses as a core innovation. Topics included materials for optical components, advances in molding technology (burning rods, GOB+milling, and one-step molding), and the importance of aspheric accuracy. Comparisons showed that accuracy improvements from 60 μ m to 10 μ m significantly impact projection quality.



Application cases demonstrated the difference between systems with and without glass aspheric surfaces. At both 100-pixel and 25K-pixel levels, glass aspheric designs delivered better optical performance and stability across temperature variations, outperforming plastic alternatives.

Additional examples showed applications in DLP system collimators (46 mm, PV 10 μ m), AR HUD collimators (75 mm, PV 30 μ m), and HD/DLP projection functions with precision aspheric components.

Alex wrapped his presentation with a company profile of Huaju Optic, showcasing its plants in Jiaxing (20,000 m², 160 staff) and Jinhua (40,000 m², 350 staff), alongside a worldwide sales network spanning the US, Europe, Asia, and North Africa.



Huaju Optic demonstrated how glass aspheric lenses and advanced optical designs are key for quality automotive projection systems, enabling safer driving and improved user experiences.

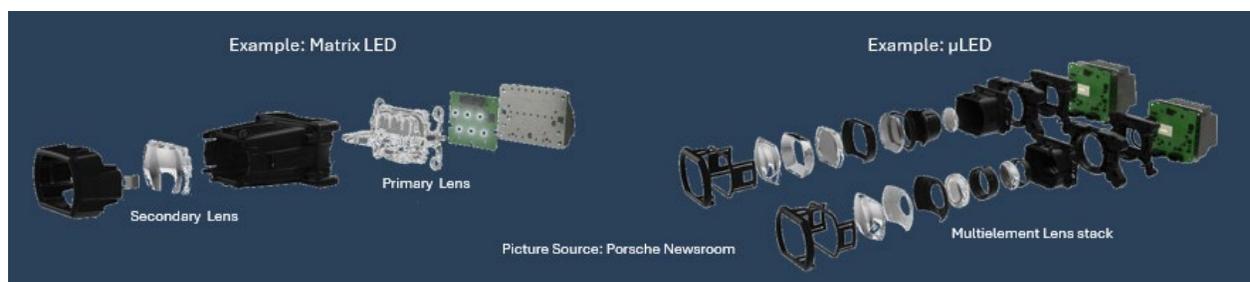
Sunex - “Lens Hybridization for μ LED Headlamps, Balancing Cost, Size, and Optical Performance”

Ingo Foldvari

Sunex introduced its perspective on the shift toward adaptive, high-resolution μ LED lighting in automotive headlamps. Market trends are driving this adoption to include higher safety features such as ADB and new branding opportunities for OEMs. However, these benefits bring challenges in optical design, electronic integration, thermal management, manufacturing, and , very important, cost.



The comparison of Matrix LED vs. μ LED optical systems highlighted the increased complexity of μ LED designs. Matrix LED systems typically use 1–3 optical elements in glass or plastic, assembled with $\sim 50 \mu\text{m}$ alignment tolerance. By contrast, μ LED optical systems require 4–5 elements, tighter tolerances ($\sim 5 \mu\text{m}$), and pre-aligned barrel assemblies. This higher precision reflects the compact yet powerful nature of μ LED sources.



To balance cost, size, and performance, Sunex suggests focusing on lens hybridization, combining glass and plastic optical elements. The reasoning is that glass provides thermal stability, lifetime reliability, and predictable performance, while plastics enable difficult shapes, lower costs at volume, and are faster to prototype. However, plastics face challenges such as higher CTE values, lower stability, moisture absorption, and transmissivity changes (yellowing).

Lens Hybridization in μ LED Headlamps

Lens hybridization (combination of glass and plastic optical elements) can bring the right balance.

	Optical	Thermal	Process	Reliability
Glass Elements	<ul style="list-style-type: none"> Large selection of different glass types High index and Abbe Well known choices 	<ul style="list-style-type: none"> Can be close to μLED source Low CTE value Lifetime stable Very predictable behavior 	<ul style="list-style-type: none"> Component mfg. and coating process is well understood Non radial symmetric shapes increase cost 	<ul style="list-style-type: none"> Known to pass automotive REL testing, incl. coating High lifetime stability
Plastic Elements (PC, PMMA)	<ul style="list-style-type: none"> Aspherical surfaces come for “free” Not as good as glass High-end plastics have a 10x cost factor 	<ul style="list-style-type: none"> PMMA has a low vitreous transition temperature Higher CTE value Not Lifetime stable Althermalization with only 1 plastic type not ideal 	<ul style="list-style-type: none"> Great to realize specific shapes (e.g., rectangle) Very cost effective in high(er) volumes Requires tooling already for prototypes 	<ul style="list-style-type: none"> Lower abrasion resistance (last element) Coating Cracking likely Exhibits “aging” over lifetime

Sunex NextGen Compact Lens Design

Reducing Size (Reduce cost) leads to Good/High Performance.

A. Lens can scale with μ LED chip size
 B. But still has to consider the temperature gradient

Original Lens: HFDV: 24", Cap OD: 58.2mm, TTL: 26mm, Structure: Hybrid
 New Compact Projectors: HFDV: 24", Cap OD: 42mm, TTL: 46.4mm, Structure: Hybrid; HFDV: 48", Cap OD: 32.8mm, TTL: 31.1mm, Structure: All Glass

The presentation discussed thermal and lifetime stability considerations, showing how repeated high-temperature exposure and material aging affect optical index and performance. High-end automotive plastics address these issues but can cost 10–20 times more than PC or PMMA.

Design constraints include performance targets such as cost, resolution, efficiency, color aberrations, and OEM geometry requirements. The impact of material type, element position, and coatings on optical results must be carefully evaluated.

Impact on Performance

- Challenging (Orange)
- Positive (Green)
- Neutral (Yellow)

	Cost	Resolution	Efficiency	Color Aber.	Geometry
Material	Positive	Neutral	Challenging	Challenging	Challenging
Position	Challenging	Challenging	Challenging	Challenging	Challenging
Shape	Positive	Positive	Challenging	Challenging	Positive
Coating	Challenging	Challenging	Challenging	Challenging	Challenging

General guideline. Individual design performance can vary.

Looking ahead, next-generation μ LED technologies will allow more compact optical systems. Examples included Sunex designs ranging from all-glass to hybrid structures, with different HFOV, outer diameters, and total track lengths optimized for μ LED chip scaling while managing temperature gradients.

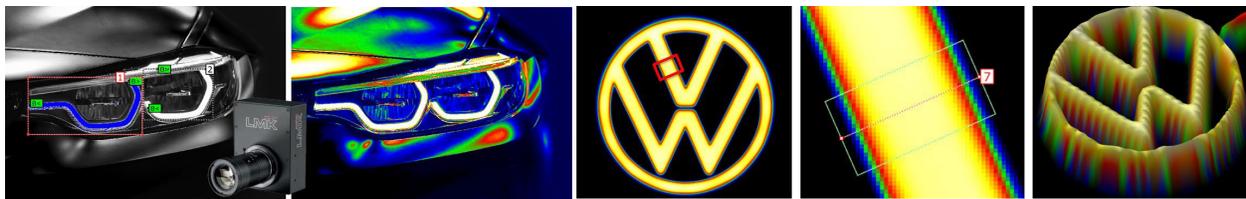
In conclusion, Sunex stated that hybridization is a key pathway to balance cost, size, and optical performance. Success depends on material selection, precision design, and robust processes that ensure thermal stability and reliability in μ LED headlamp applications.

TechnoTeam Vision USA - “Photometric tools to help convey your message with light”

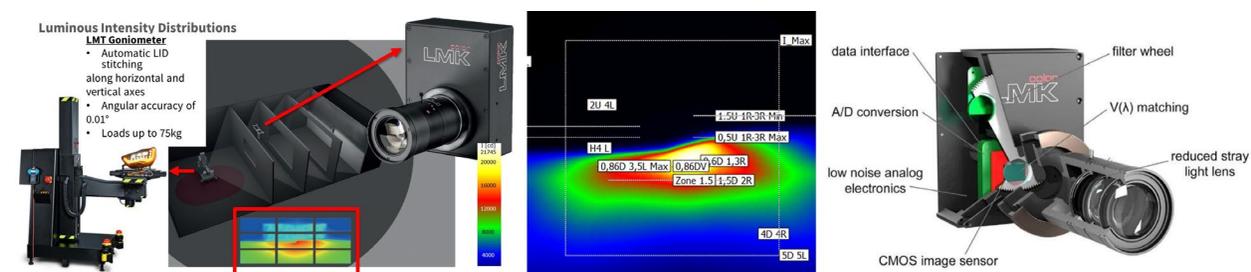
Bradley Mucha

TechnoTeam introduced itself as a designer and manufacturer of high-precision, high-accuracy imaging luminance measurement devices. With a worldwide network of distributors and a U.S. subsidiary founded in 2018 in Orlando, FL, the company supports the automotive industry in quantifying and validating light performance while ensuring compliance with standards and preserving aesthetics.

The presentation addressed the question: How do we communicate brand identity through light? TechnoTeam showed how the elegant use of photometry and colorimetry provides objective data for design evaluation. Direct headlamp measurements can assess overall brightness, uniform brightness, and color accuracy. Brightness is measured through luminance statistics, uniformity is checked by analyzing homogeneity, and color is evaluated using chromaticity coordinates in multiple color spaces.



These methods extend to lighted signatures and backlit logos or grilles. Complex shapes can be automatically evaluated using “symbol object” statistics, and homogeneity across logos can be calculated with Weber or Michelson contrast formulas. Luminance images, 3D luminance maps, and projection lines provide detailed insights into contrast and sharpness, even for small cross-sections of a logo.



TechnoTeam also presented Luminous Intensity Distributions (LID) as another important evaluation tool. Using its LMK6 camera and LMT goniometer, procedures can be created, stored, and reused across laboratories. Automatic LID stitching along horizontal and vertical axes ensures angular accuracy of 0.01°, while load capacities up to 75 kg allow full headlamp testing. Pass/fail reports and database integration streamline workflows.

In conclusion, TechnoTeam demonstrated how its photometric tools enable automotive designers and engineers to measure, evaluate, and communicate lighting performance. From headlamp beams to illuminated brand signatures, these methods combine precision with usability, ensuring compliance and helping light convey both function and identity.

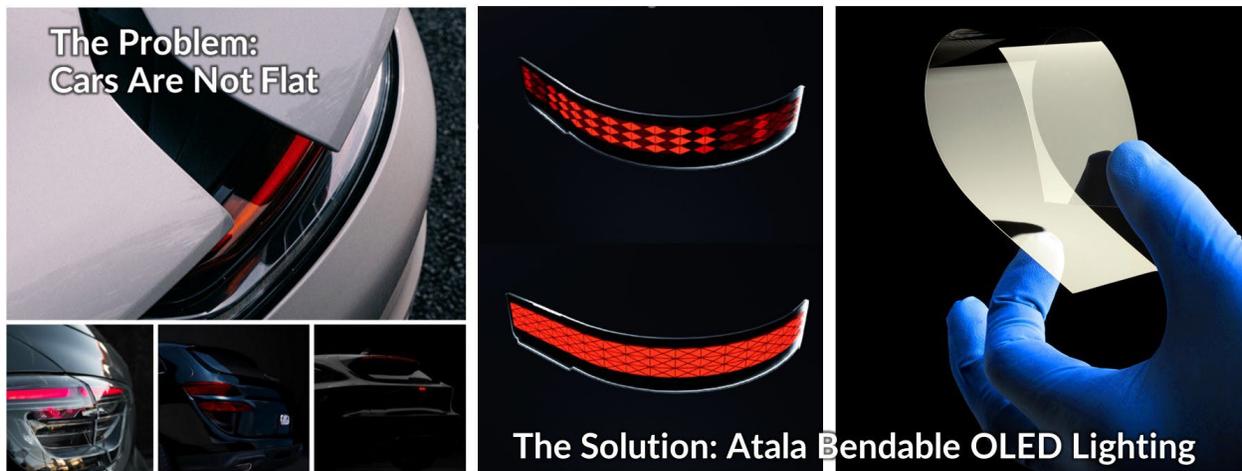
OLEDWorks - “Bendable OLED: Shaping New Opportunities for Automotive Lighting”

Dr. Michael Boroson

Dr. Michael Boroson explained the problem for rear illumination is that cars are not flat. Vehicles have three-dimensional, curved architectures, while most current lighting solutions rely on optics and positioning to mimic curves. Manufacturing flexible lighting that meets stringent reliability and lifetime requirements of over 15 years has been a persistent challenge.

The solution proposed was the Atala Bendable OLED Lighting. Built on ultra-thin (0.1 mm) Corning® Willow® Glass, it can bend to a minimum radius of 200 mm while maintaining moisture

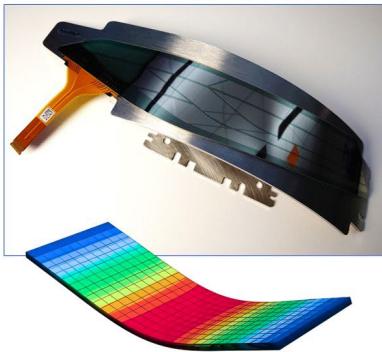
resistance and chemical durability superior to plastic substrates. These panels pass the same strict automotive validation tests as rigid OLEDs.



Development involves finite element analysis (FEA) to model the full assembly, OLED panel, flexible PCB, molded fixture, and adhesives. Stress profiles account for bending, thermal shifts, mechanical shocks, and vibrations, guiding optimization. OEMs, Tier 1, Tier 2, and Tier 3 partners contribute in a highly collaborative process.

Validation of reliability is achieved through accelerated testing, using smaller bend radius to simulate long-term durability within hours or days. Thin film encapsulation ensures environmental protection, delivering products designed to last 15+ years under typical automotive conditions.

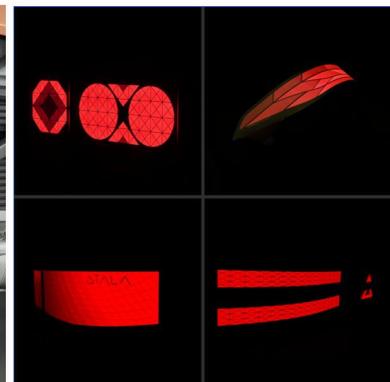
Collaborative Design for Robust Performance



Increased Visibility for Safer Driving



Future of Bendable - What Comes Next



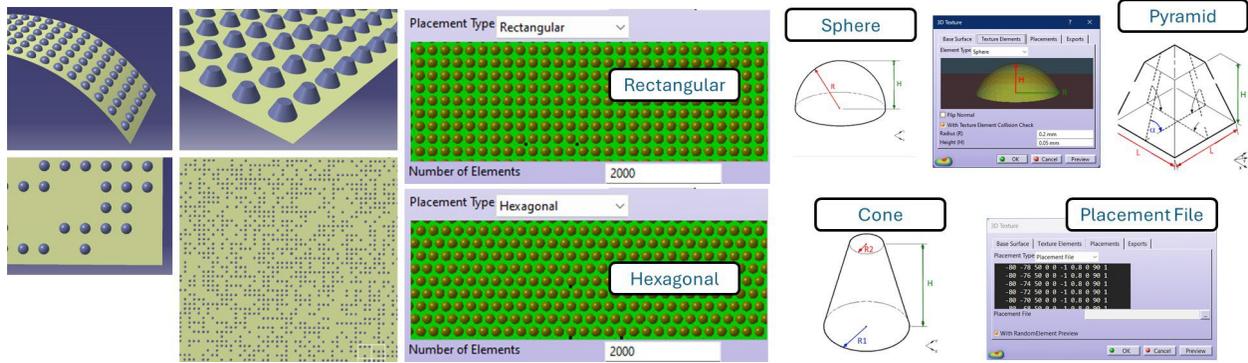
Curved OLED panels also provide safety benefits, enhancing visibility and spatial awareness. Their Lambertian emission profile ensures uniform illumination at wide viewing angles, helping drivers judge vehicle width and reducing collision risk, especially with motorcycles.

Beyond safety, bendable OLEDs expand design and communication possibilities. They integrate seamlessly with curved vehicle architectures, enable unique brand differentiation through signature designs, and support dynamic animations for vehicle-to-everything (V2X) communication.

Looking ahead, OLEDWorks presented the future of bendable OLED technology: up to 128 segments per panel today with prototypes demonstrating hundreds, brightness levels reaching 20,000 cd/m² for stop and turn functions, and expanded color options including amber, white, and cyan.

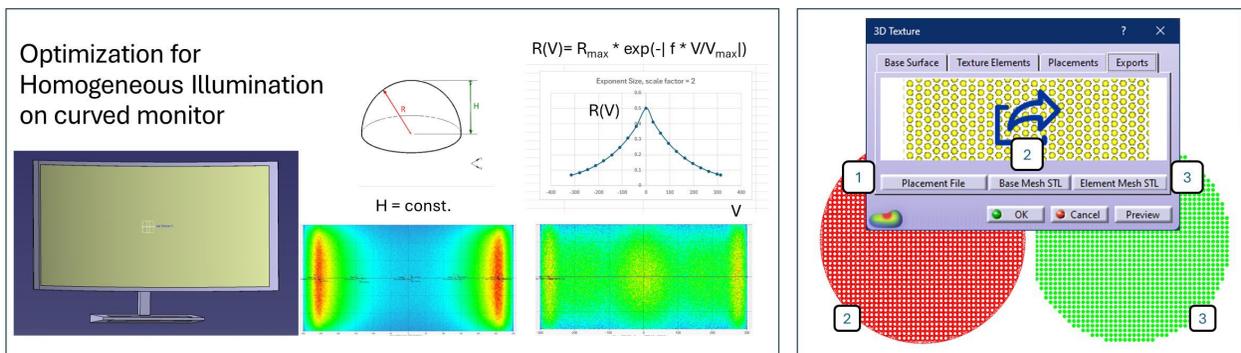


The Atala Bendable OLED was positioned as the next wave of innovation, ready for vehicle integration today with the same reliability and performance as rigid products, but with unmatched design flexibility.



Export capabilities were highlighted, including placement files (coordinates and parameters), base mesh STL files (cut-outs for textures), and element mesh STL files (texture elements alone).

The team then presented micro-optic patterns generated from bitmap images. Each pixel of an image maps to a UV coordinate on a surface, with greyscale values controlling either the height or radius of the optical feature. This method allows icons, symbols, or images to be directly converted into optical textures for lighting applications.

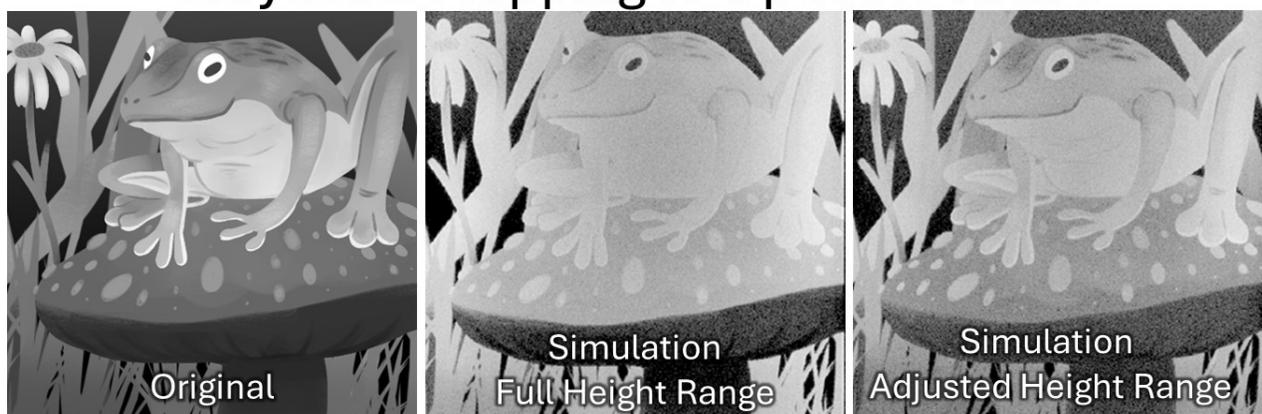


A tool in LucidShape CAA creates these textures quickly, producing thousands of features within minutes. Simulation results with 500 million rays showed patterns that remain visible at off-axis angles, demonstrated with a vehicle emblem example.



Finally, greyscale tone mapping was introduced to refine optical features. Simple mapping (height proportional to greyscale) often lacks dynamic range, while optimized mapping improves feature differentiation. Side-by-side simulation comparisons showed how adjusted mapping better represents image contrast in optical features.

Greyscale Mapping to Optical Feature



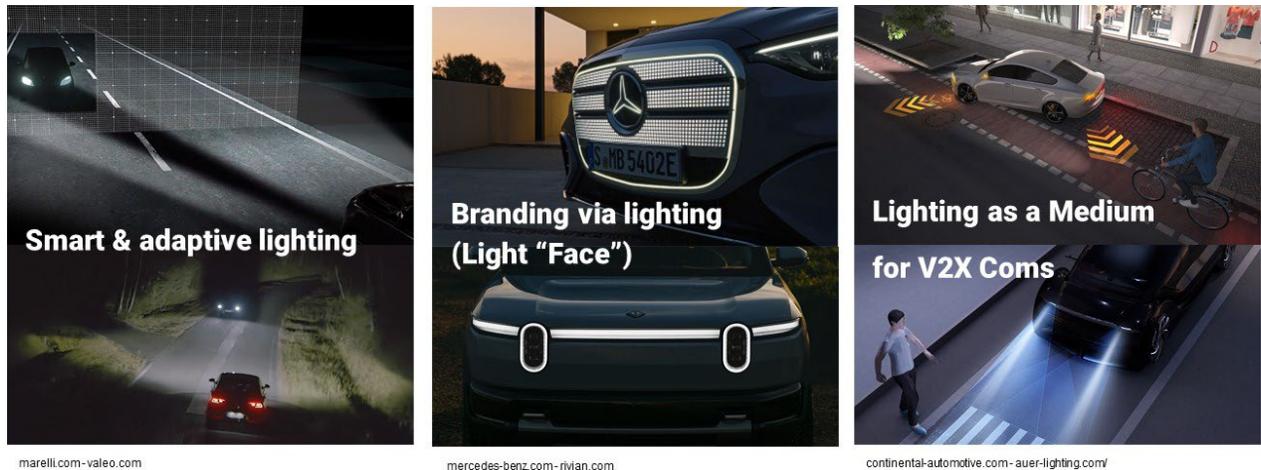
In summary, Thomas demonstrated that microstructure design tools, 3D textures, bitmap-driven optic patterns, and greyscale tone mapping, provide powerful methods to integrate styling, symbols, and functional optics into vehicle lighting, enabling efficient, uniform, and customizable illuminated surfaces.

United Visual Researchers - “Streamlining Lighting Design Collaboration with Predict Suite’s API”

Thomas Labardens

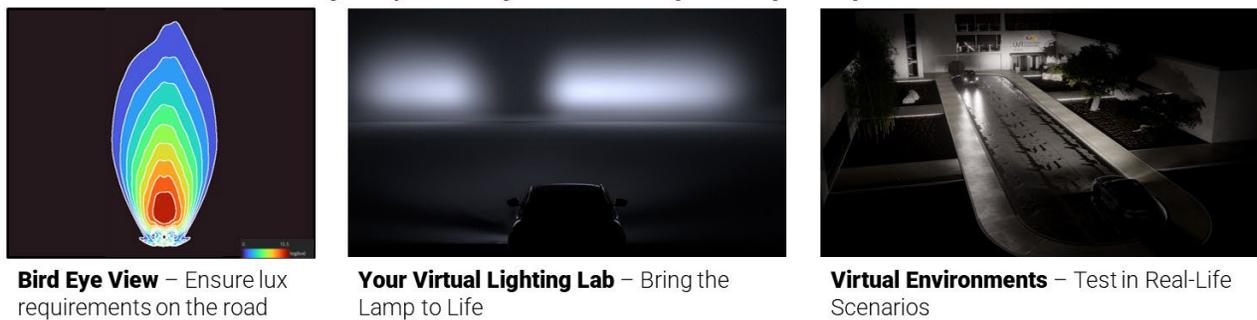
UVR presented its Predict Suite, a platform that connects optical simulation with high-end visualization to create true-to-life digital mockups. By importing measurement files, including spectral, polarization, and material properties, the system ensures accuracy and cross-compatibility, enabling designers and engineers to bring concepts to life while giving decision-makers confidence in their choices.

Thomas showed how UVR’s work is at the crossroads of styling and engineering collaboration, offering a “single source of truth” from perceived appearance to optical validation. Applications highlighted included adaptive driving beams, matrix LEDs, and sensor-driven systems for glare-free safety, branding through animated light signatures, and lighting as a medium for V2X communication with pedestrians and other road users.

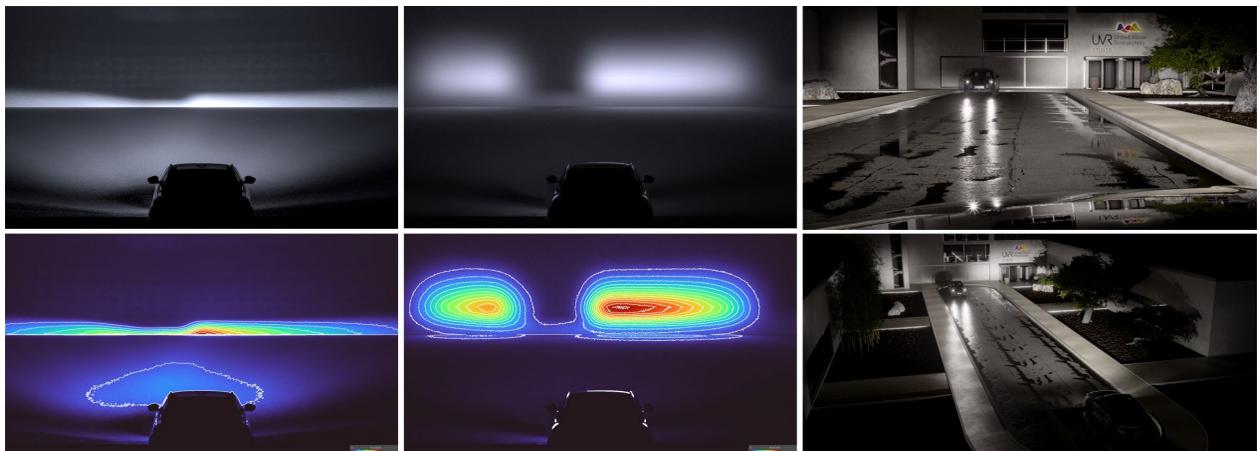


In the matrix beam use case, Predict Engine supports validation of beam shaping and photometric compliance early in development, virtual testing of glare-free algorithms, and accelerated prototyping of adaptive optics. The tools guide the entire headlamp development process, from bird’s-eye lux validation to white wall testing and full virtual environments.

A dedicated **set of tools** to guide you through the **headlamp development process**



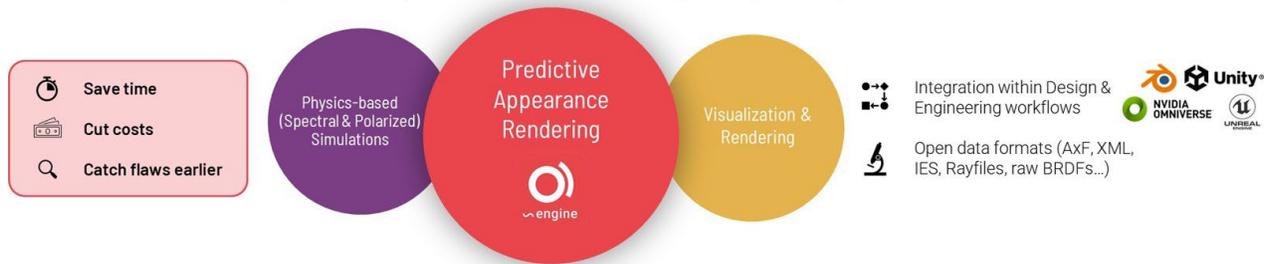
Bird’s-eye view tools ensure irradiance and photometry requirements on the road are met, while the virtual lighting lab reproduces wall tests, compares simulated and physical beams, and accelerates iteration cycles. Designers can also place vehicles in customized virtual environments, simulating urban, rural, highway, or varied weather conditions. This allows testing in real-world scenarios while staying entirely digital.



Thomas also outlined the general workflow, covering CAD preparation, asset imports, rendering setup, and analysis. Inputs such as measured materials, lights, and environments feed into Predict

Matter and Predict Lab, producing both hero shots and optical analysis outputs. Supported formats include EXR, PNG, MP4, and CAD/3D model types.

Predict Engine enables you to **streamline** your **Design & Engineering** workflows



Finally, UVR emphasized how the suite helps different teams: decision-makers can eliminate design bottlenecks, visualization artists save up to 60% time on asset prep, engineers automate CAD-to-3D conversion, and stylists optimize assets for interactive rendering.

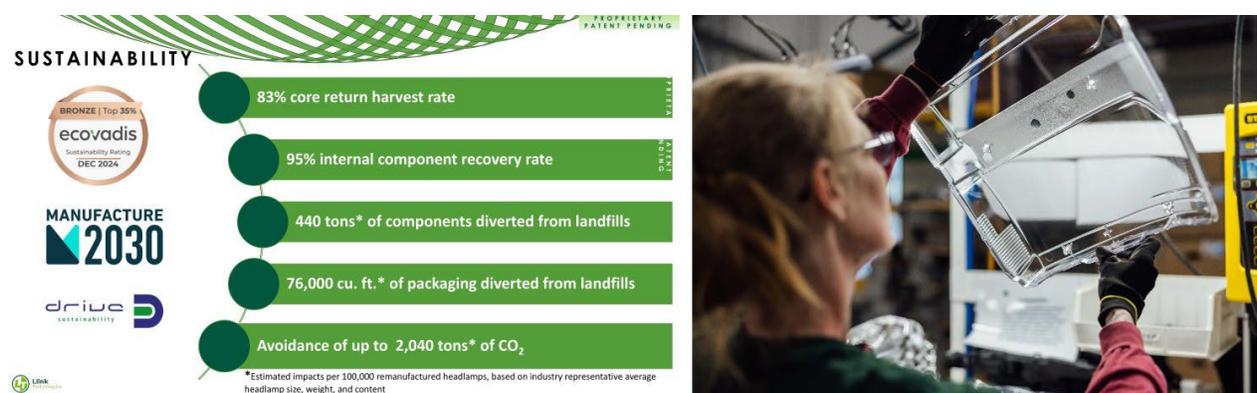
UVR’s Predict Suite demonstrates how digital workflows can unify styling and engineering, reduce iteration cycles, and enable highly realistic virtual testing of advanced automotive lighting systems.

Link Technologies - “Advanced Remanufacturing for Modern Lighting: Where Innovation Meets Responsibility”

Chelsea Jensen

Link Technologies presented its automotive lighting assembly remanufacturing solution, designed to be adaptable for any OE, model, or lighting technology. The process was described as being built for the future of lighting, combining innovation with responsibility.

Chelsea emphasized why remanufacturing matters more today. “Lighting today is a combination of safety and design; it improves visibility, communication and function as a styling element that attracts buyers and reinforces brand identity.” She mentioned.



Remanufacturing was positioned as a key enabler of circularity, bridging the growing gap between increasingly complex lighting systems and the rising demand for sustainability and circularity. By offering design-for-remanufacturing insights, Link helps OE partners balance aesthetics, performance, and long-term serviceability. The sustainability potential was quantified with estimated environmental benefits per 100,000 remanufactured headlamps, showing significant reductions in material usage and emissions.



Chelsea described Link’s remanufacturing process, which includes careful harvesting of components, specialized assembly and testing. In-line and full photometry testing ensure compliance with OE standards, supported by third-party validation partners.

Link Technologies positioned remanufacturing as both a practical and forward-looking strategy, one that delivers sustainability, cost efficiency, and long-term value, while supporting the industry’s shift toward circular economy practices.

Magwerks - “Innovative Headlamp Optical System and Construction”

Michael Pickholz

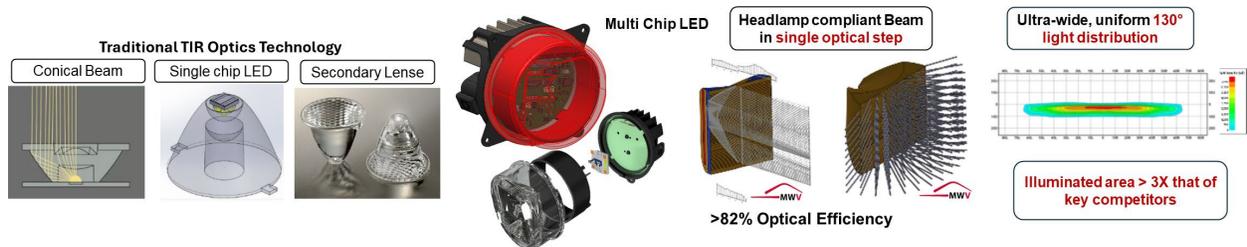
Magwerks presented its portfolio of lighting solutions spanning the broad mobility market, including blackout headlights, plug-and-play silicone LED modules, and a range of 90 mm, 65 mm, and PAR 36 LED lamps used in low beam, high beam, fog, and auxiliary applications. These products extend into both automotive and military vehicles, such as the M109A6 and M1283 AMPV.

A key theme was the integration of silicone optics with outer lenses. By simplifying builds into single-piece moldings, Magwerks combines multiple illumination functions with integral separators and reinforcements. This enables practical solutions such as lens-less headlamps integrated into exterior body elements like grilles, supported by the compliance of optical silicone.

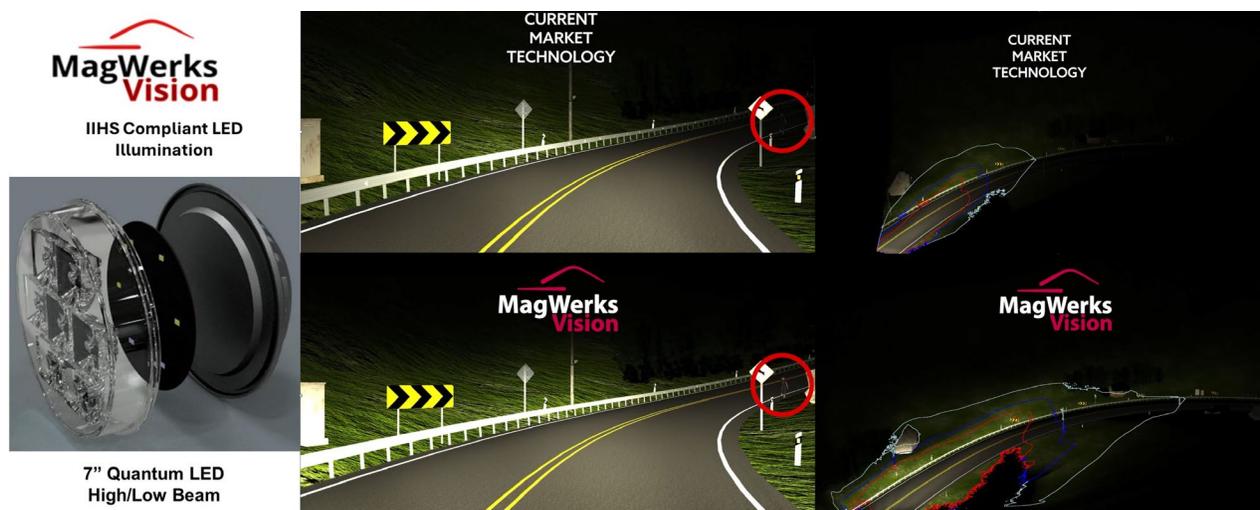


Michael highlighted its Ultra-TIR technology, which delivers headlamp-compliant beams in a single optical step. Using conical beam optics, it achieves ultra-wide uniform 130° light distribution, over three times the illuminated area of key competitors, while maintaining >82% optical efficiency.

Magwerks highlighted the global importance of effective low-beam illumination. In India, where nighttime accidents are rising, wide beams with strong near-field coverage are essential, targeting 40 meters (131 ft) width at 25 meters ahead. This aligns with both OEM targets and U.S. military specifications for LED headlamps, which share similar photometric requirements. (Suggested image: “Good Low Beam Illumination a MUST Worldwide” slide –)



Michael also presented its IHS-compliant 7” Quantum LED high/low beam lamp, which delivers more than twice the illumination compared to conventional designs. Additional benefits include 50% weight reduction as well as 50% lower power consumption while is fully recyclable.



Magwerks presented how the integration of optical silicone, advanced TIR technology, and innovative system design can meet global performance requirements, improve safety, and deliver sustainable lighting solutions across both civilian and military applications.

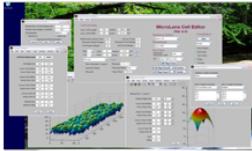
Brightview Technologies - “Novel Automotive Lighting Solutions Using Computational Optics”

Jennifer Aspell

BrightView Technologies introduced its approach to computational optics as a novel path for automotive lighting solutions. The process begins with AI-driven software design, enabling multi-functional and complex structures that combine variable shapes, densities, and patterns within a single device, creating an almost limitless design space.

BRIGHTVIEW'S DIFFERENTIATED PROCESS

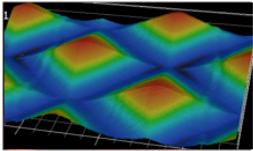
FAST, FLEXIBLE, LARGE FORMAT, SCALABLE



Step 1: AI Software Design



Step 2: Mastering



Step 3: Tooling



Step 4: Mass Production

The digital designs are then transferred to BrightView’s custom large-format grayscale photolithography system (4 ft x 8 ft), where every pixel is individually written. A full-size master can be produced in less than 24 hours, which then supports the creation of high-fidelity consumable tooling.

COMPUTATIONAL OPTICS

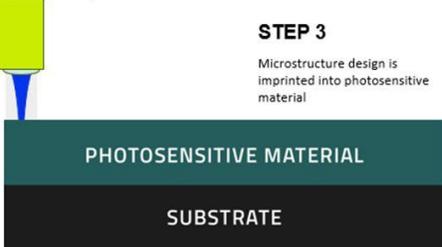
Digital Pixel Mastering

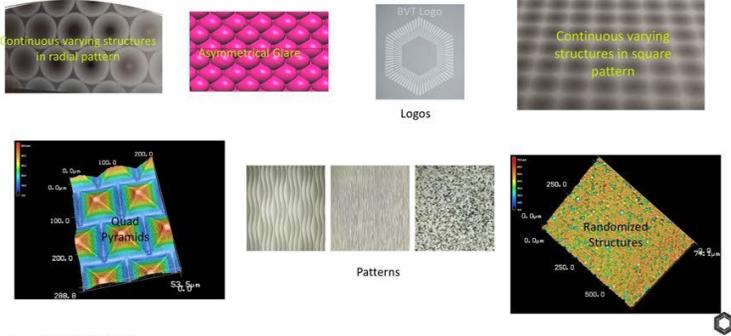
UNLIMITED OPTIONS FOR MLA DESIGN

STEP 1
Substrate combined with photosensitive material

STEP 2
Exposed to higher power laser light

STEP 3
Microstructure design is imprinted into photosensitive material





BrightView Technologies, Inc. CONFIDENTIAL

From these masters, BrightView enables mass production through a high-volume, roll-to-roll process in clean-room conditions. Products can be manufactured on a range of substrates, PET, PC, or PMMA, at many thicknesses, using proprietary resins developed in-house. The process is designed to be fast, flexible, large-format, and scalable, making it perfect for automotive applications.

Jennifer presented BrightView’s differentiated process of digital pixel mastering. A substrate is coated with a photosensitive layer and exposed to high-power laser light to print the microstructure design directly into the material, ensuring excellent accuracy.

BrightView enables unlimited design options for micro-lens arrays (MLA), from quad pyramids to patterns and even logos, allowing merging functional, aesthetic, and branding.

Automotive

BRIGHTVIEW



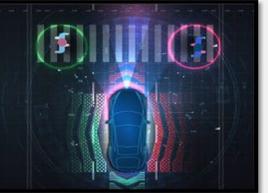
Lighting



Display



3D Sensing



AR / VR

High Performance
Functionality

+

Maximize Brightness /
EV Battery Life

BrightView positioned computational optics as a flexible, scalable, and design-rich technology that supports functional performance, aesthetic expression, and efficiency in automotive lighting, offering OEMs a powerful new tool for innovation.

DAJAC - “From Vision to Validation: One Test at a Time”

Steve Trent

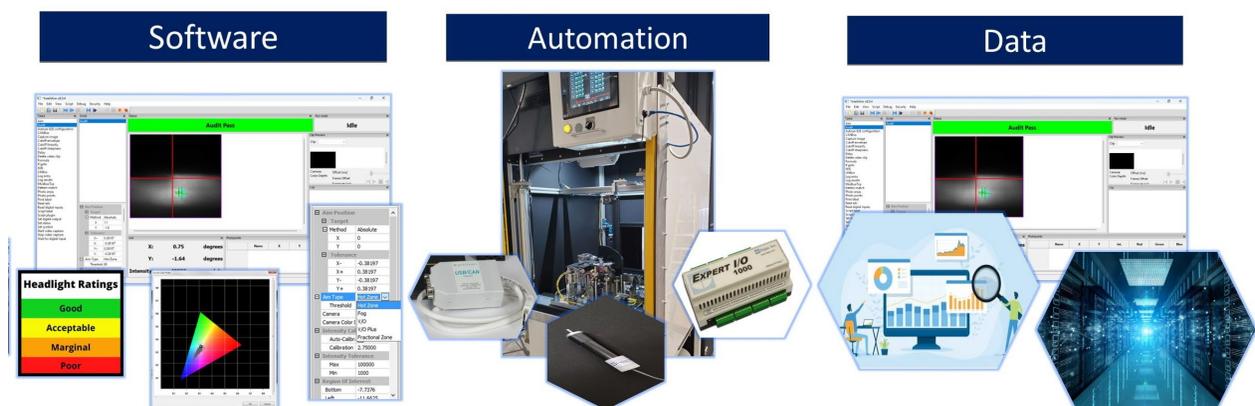
Dajac presented its expertise in headlamp alignment and light validation, a field the company has specialized in since 2000 from its base in Sheridan, Indiana. The focus was on delivering solutions that ensure precision, quality, and speed in automotive lighting validation.

Steve highlighted the importance of end-of-line (EOL) testing, where headlamp alignment and validation compliance help confirm standards beams such as ADB, IIHS, and FMVSS. EOL testing ensures that lighting systems meet safety, customer performance targets, and regulatory requirements.

Key technologies enabling this include cameras, which provide accuracy, precision, flexibility and speed in capturing measurement data, and software, which performs analysis, aiming, and configurable data processing. Software tools support tasks such as audit aim, cutoff sharpness, photo point areas, animation analysis, and IIHS-specific requirements, helping engineers validate advanced systems like adaptive driving beams.



The system is supported by automation, with PLC communication ensuring efficient interaction between testing equipment and lamps. This minimizes cycle time while guaranteeing fast and reliable delivery of results.



Captured data outputs include intensity, aim and gradient locations, color, and IIHS results, offering complete visibility into headlamp performance. Dajac solutions are fully compliant with EU2018/858 regulations, ensuring international applicability.

Dajac demonstrated its approach of combining cameras, software, automation, and data systems to provide comprehensive validation of modern automotive lighting systems, ensuring compliance, safety, and performance, one test at a time.

NanoVents - “PFAS-Free Vents Innovation: Advanced Adjustable Multilayer Nanomembrane Solutions for a Sustainable Future”

Jiří Schirl

NanoVents presented its nanomembrane-based venting solutions for automotive lighting systems. These ultrathin membranes, composed of nanofibers (1–1000 nm) arranged in multiple layers. Using organic polymer material composition, they offer high breathability, moisture vapour permeability, ingress protection, and filtration efficiency, which we leverage to achieve the required properties..

Jiří highlighted their ZeroPF technology, which ensures that NanoVents products are 100% free of PFAS, PFOA, and PTFE. This approach fully complies with EU REACH and upcoming U.S. EPA PFAS regulations, effective 2026.



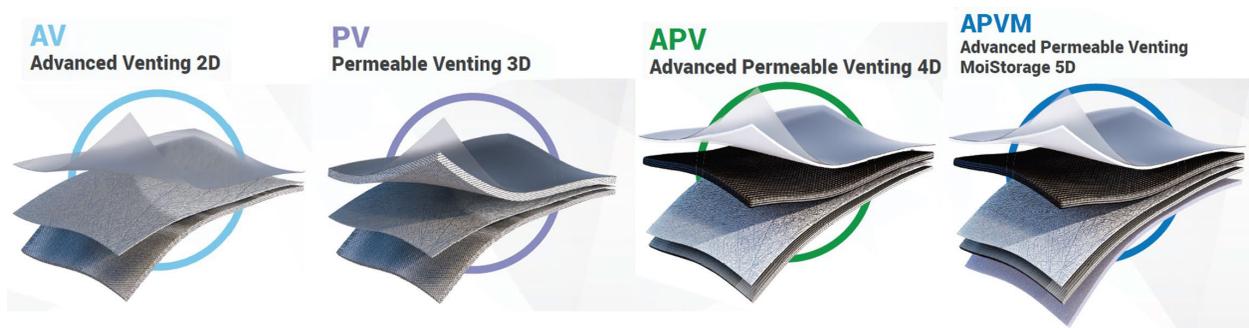
The product line includes multiple venting solutions optimized for different applications:

AV (Advanced Venting 2D): Designed for open lighting systems with maximum air circulation and excellent moisture vapor permeability, with very good resistance to dust, splash water, and automotive fluids. (headlamps (HL), acoustic vents, interior, electronics).

PV (Permeable Venting 3D): Optimized for closed lighting systems where condensation is a key concern. Offers strong airflow, effective water vapor transfer, and superb water entry pressure (WEP) resistance, a cost-saving solution for applications with limited direct exposure. Protected by NanoComposite coating. (headlamps (HL), rear lamps (RL), accessory).

APV (Advanced Permeable Venting 4D): Enhanced protection for demanding closed-system applications. Provides higher WEP performance while maintaining excellent vapor permeability and airflow, an uncompromising option for exposed or high-value components. (headlamps (HL), rear lamps (RL), Electronic Control Unit (ECU))

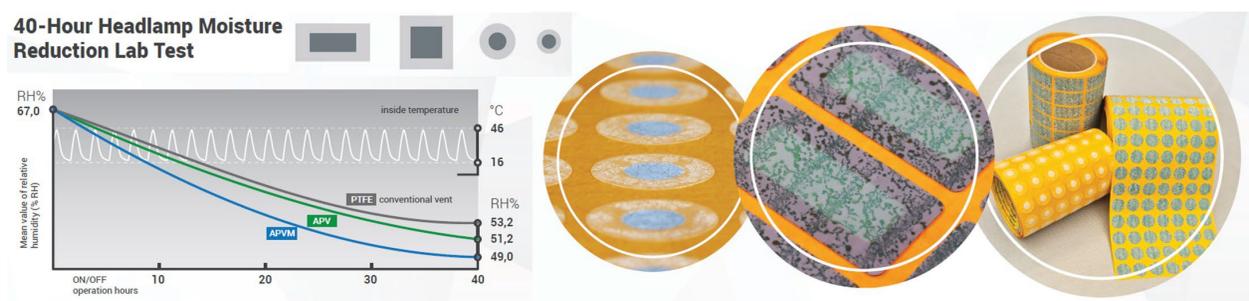
APVM (APV MoiStorage 5D): The extended desiccating version of the APV series, equipped with an internal superabsorbent MoiStorage layer. MoiStorage layer captures moisture at the vent area and facilitates its immediate release when the housing reheats and the partial pressure of water vapor increases.



Performance data shows effective moisture reduction in headlamp tests and strong results under international standards that include ISO 14419, ISO 16750-5, ISO 9237, ISO 11092, and ISO 811.

NanoVents provide reliable ventilation, pressure equalization, and long-term ingress protection across -40°C to $+120^{\circ}\text{C}$ for robust global outdoor automotive applications.

Applications include headlamps, rear lamps, ECUs, acoustic vents, and electronics. Products are delivered in multiple application formats such as low-tack carriers, belts, or ultrasonic welding for seamless integration.



NanoVents' PFAS-free nanomembrane technology as a game-changing solution for the automotive industry, offering high-performance venting and protection while aligning with global OEM requirements and regulatory goals.

SESSION 3 : REGULATION

Mercedes-Benz - “Mercedes-Benz ADS Marker Light Questionnaire and On-Road Study” **Nik Sciortino**

Mercedes-Benz presented its research on ADS Marker Lamps as a means of external human-machine interface (HMI) for automated driving systems (ADS). As ADS-equipped vehicles enter the market, studies indicate that road users prefer clear signals to show when ADS is engaged and to anticipate vehicle intentions.

Global feedback supports this approach. A 2024 multi-country survey (UK, Japan, US, Germany) with over 4,400 drivers showed that more than 70% of respondents, and over 80% in Germany, believe ADS Marker Lamps are necessary for all vehicle types. They are seen as beneficial for anticipating automated movements, assisting law enforcement, and reducing driver frustration when ADS vehicles follow speed limits. Most respondents preferred high-visibility, mid-height placement.



Mercedes-Benz R&D explored prototype designs and color preferences. Pedestrians and drivers favored a 360° view and a blue-green lamp color, aligning with SAE standards. SAE J3134 (2019) defines ADS marker lamps as steady-burning, activated only when ADS is engaged, and uniquely blue-green to avoid confusion with other lights. SAE J578 established chromaticity requirements, ensuring distinction from signaling blue.

Field validation began in California, where the Highway Patrol authorized a two-year on-road trial starting in November 2023 using five EQS vehicles with ADS marker lamps. Nevada also permitted their installation on 2026 Mercedes-Benz production models. Data collection included road user interactions and online surveys.



The on-road study showed that ADS marker lamps did not negatively impact surrounding drivers. Following distance increased slightly with lamps on (+0.037s, +1.1 ft), and aggressive driving behaviors (cut-ins, harsh braking, etc.) remained statistically unchanged.

An online U.S. questionnaire with 1,767 participants (including 39 law enforcement officers) tested impressions from videos and images. Results showed 82% of road users and 75% of law enforcement rated lamp visibility as non-distracting. While most participants did not immediately link the lights to automated driving, 44% strongly agreed they provide a safety benefit, and overall support was high. Concerns included lack of public understanding, possible distraction, and skepticism toward automated vehicles in general.

ADS Marker Lamps does not impact the driving behavior of surrounding drivers, nor aggressive driving from others

Speed	Avg Distance (thw)			Distance (feet)		
	Off	On	Var	Off	On	Var
00-10	195.1	196.6	1.6	14.3	14.4	0.1
10-20	171.3	174.5	3.2	37.7	38.4	0.7
20-30	158.1	160.6	2.5	58.0	58.9	0.9
30-40	150.7	152.5	1.8	77.4	78.3	0.9
Total	165.4	169.0	3.7	48.4	49.5	1.1

Event Type	Events	
	Lights Off	Lights On
Cutin	30	35
Cutin_cutout	1	8
Cutin_nbr	2	2
cutout		4
Motorcycle	3	3
Total	36	52
Sample Hours	140.79	180.74
Events/Hour	0.26	0.29

In conclusion, ADS Marker Lamps are perceived positively as a transparency measure and safety benefit. By signaling ADS engagement with a recognizable blue-green lamp, they can enhance trust and communication. Mercedes-Benz noted that public education will be essential to address concerns and ensure successful adoption.

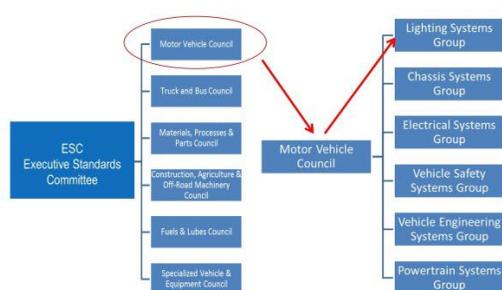
General Motors / SAE - “Introduction – Standards Development Program in Lighting Systems Group”

Michael Larsen

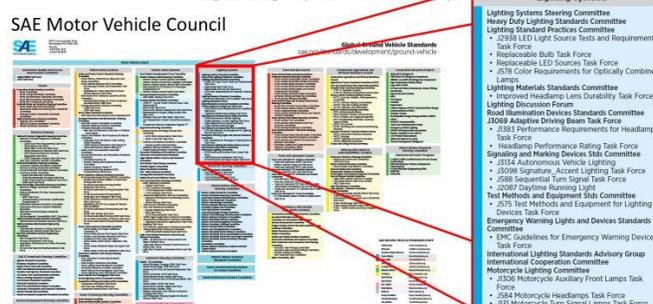
The SAE Lighting Systems Group (LSG) is a technical standards development body made up of more than 60 active volunteer members. Its participants include automakers, lighting assembly and source manufacturers, test equipment and materials suppliers, universities, research institutions, regulatory agencies, and other stakeholders. The group operates under the SAE Motor Vehicle Council and Executive Standards Committee.

SAE has been involved in lighting standards development for more than 110 years. Milestones include the first headlighting requirement study in 1914, joint IES-SAE headlighting specifications in 1918, adoption of dual-beam standards in 1930, creation of SAE J599 (inspection code) in 1936, SAE J579a (sealed beam headlamps) in 1940, SAE J1889 (LED signal lighting devices) in 1988, SAE J2650 (performance requirements for LED road illumination devices) in 2005, and SAE J3069 (adaptive driving beam) in 2016. By 2025, the group manages over 75 active technical reports.

SAE Ground Vehicle Standards Committees



Society of Automotive Engineers (SAE)
Lighting Systems Group



Current work includes developing SAE J3308 (road projections), SAE J3288 (ADB test parameter clarification for FMVSS 108), SAE J3283 (exterior lighting in park condition), and updating several long-standing standards such as SAE J3098 (decorative lamps), SAE J3134 (ADS marker lamps), SAE J599 (inspection code), SAE J2999 (effective projected luminous lens area), SAE J588 (turn signals), and SAE J576 (plastic materials for optical parts).

Other SAE LSG activities are also engaged in forums and discussions on key industry topics, including glare, automatic emergency braking impacts on headlights, PWM for lighting, NCAP ADB reviews with NHTSA, and whole-vehicle certification of lighting. International cooperation with GRE and GTB ensures alignment with UN regulatory efforts.

The group maintains a wide scope of standards committees, covering heavy-duty lighting, signaling and marking devices, emergency lights, international cooperation, test methods, road illumination devices, lighting materials, and motorcycle lighting. Dedicated taskforces also address replaceable bulbs and regulatory cooperation.

In closing, Michael Larsen encouraged wider participation in upcoming task force meetings, underscoring the importance of keeping SAE standards relevant and adaptive to new technologies in automotive lighting.

“Status Report of SAE J3283TM Exterior Lighting Use During the Park Condition of a Vehicle Task Force and SAE J3098™ Front Decorative Lamp”

By Dennis Novack from Stellantis / SAE

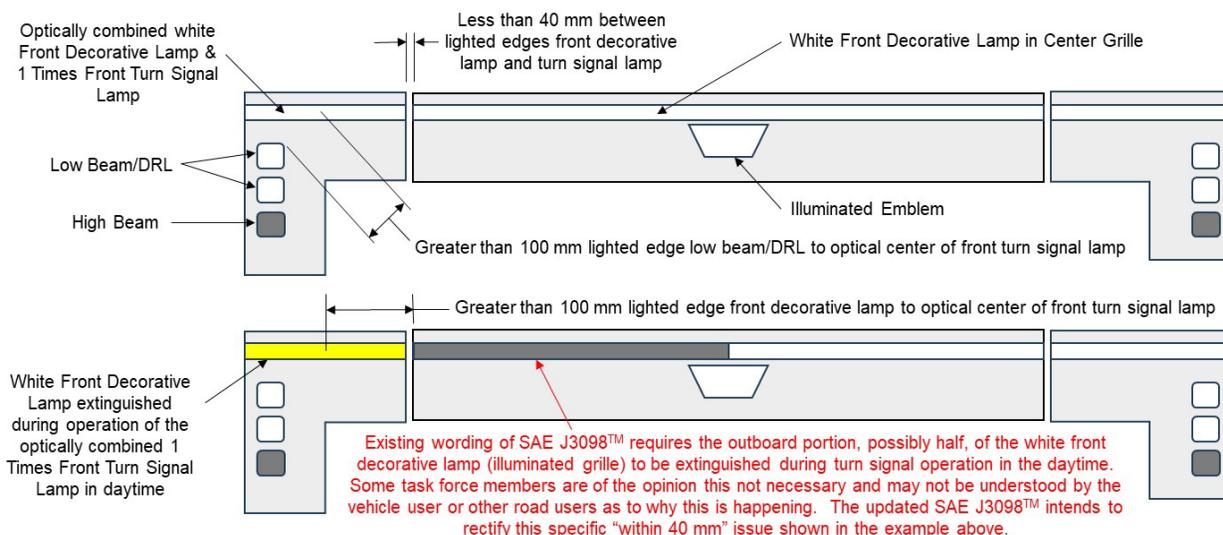
The presentation provided a status update on two active SAE recommended practices under review: SAE J3283 (Exterior Lighting Use During Park Condition) and SAE J3098 (Front Decorative Lamps).

SAE J3283 establishes installation, design, and performance requirements for exterior lighting when a vehicle is stationary and propulsion is disabled. Applications include EV battery state-of-charge lighting, charging indicators, exterior courtesy lighting, welcome and departure animations, panic alarms, and theft deterrent lighting.

The task force has reviewed sixteen draft versions, three of which were balloted without unanimous approval. Three unresolved topics remain: (1) allowable time duration for welcome/departure animations, (2) allowable colors of light during these sequences, and (3) allowance for backup lamps to be illuminated outside of reverse mode. A June 2025 meeting recommended surveying the full SAE Lighting Systems Group membership for consensus.

Survey questions, open until September 19, 2025, focus on acceptable animation duration (3s vs 10s), permitted colors (any vs specified per standard), and conditions under which backup lamps may provide illumination without reverse engaged.

SAE J3098 defines requirements for front decorative lamps, which provide white or yellow light for aesthetics or brand identity without impairing mandatory lighting functions. The practice is undergoing its mandatory five-year review, with a fifth ballot closing September 13, 2025. Updates address illuminated grilles/logos on new BEVs, clarify photometry for lamps spanning the vertical centerline, and revise rules for proximity to front turn signals.



One key issue is when decorative lamps are positioned within 40 mm of turn signals. Current wording requires portions of the lamp to extinguish during turn signal operation, which some members feel is unnecessary and confusing for drivers. The updated J3098 seeks to resolve this by refining proximity rules.

In summary, Novack highlighted ongoing SAE work to ensure park condition lighting and decorative lamps balance innovation, safety, and clarity for road users. Pending surveys and ballots will determine the resolution of open issues and updates to these critical lighting standards.

Sapphire Technical Solutions (STS) - “ADB Measurement”

Michael Piscitelli

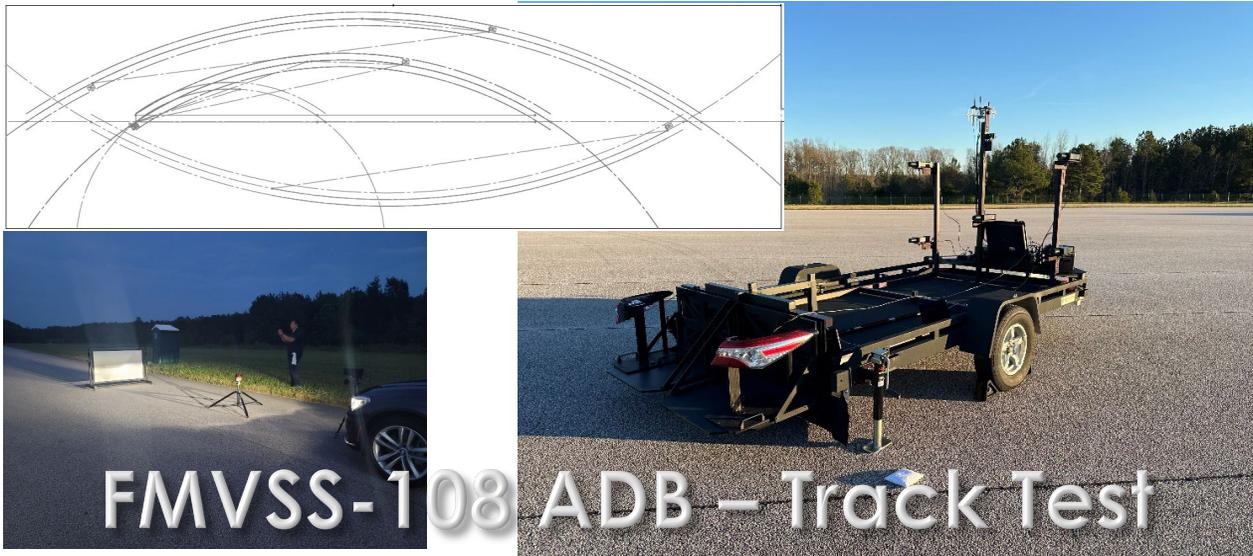
STS, an ISO-17025 accredited testing service and photometric equipment manufacturer, presented its expertise in FMVSS-108 Adaptive Driving Beam (ADB) testing. The company provides accredited photometric, radiometric, and FMVSS-108 services from its Pineville, NC headquarters.

The track test methodology covers eight scenarios with opposing and preceding vehicles (cars, trucks, motorcycles). Stimulus lamps remain active during runs while illuminance and vehicle pitch are recorded at varying distances to account for track imperfections. Test preparation includes fuel fill, tire inflation, proper vehicle weighting, and lamp aiming. A complete test cycle consists of 24 runs, using three stimulus lights per scenario.



Challenges and concerns were noted across four areas:

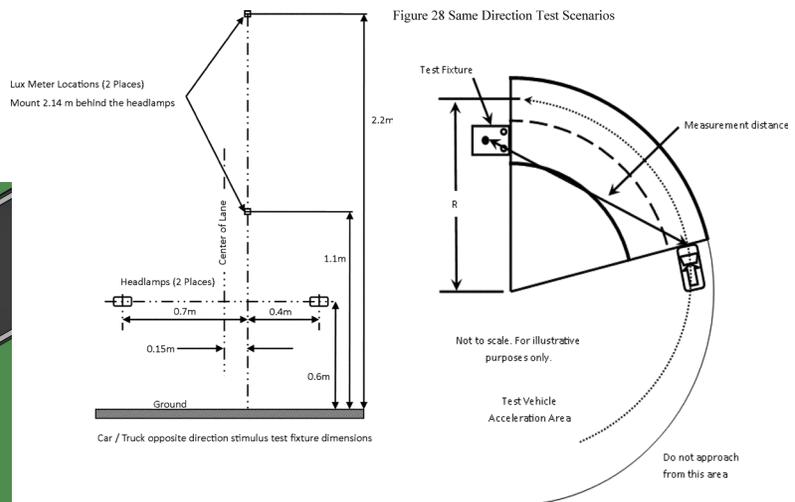
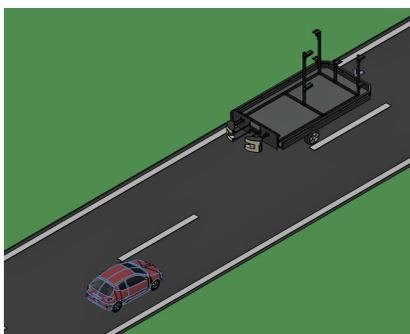
- Track issues: pavement reflectivity, ambient light, limited track size, slopes, and curve layouts.
- Setup issues: track layout, aiming accuracy, and photometer positioning.
- Testing issues: lane keeping, speed control, photometer performance, and stray light.
- Customer issues: prototype lamps, system controls, mounting problems, and regulatory scope creep.



STS highlighted future testing possibilities, including additional photometers for FMVSS-127 pedestrian AEB, visibility-focused glare measurements, and semi-automatic headlamp beam switching for non-ADB systems.

Michael detailed its TDA-200 and RITT (Road Illumination Testing Trailer), equipment widely used by customers such as Rivian, Toyota, Ford, GM, Volvo Truck, and DEKRA. The TDA-200 provides automated GPS-synced photometer readings and compiles results into reports within 30 seconds of test completion, eliminating manual post-processing.

Stimulus Lights and Detector Layout



Supporting hardware includes the Photo-150 high-accuracy photometer, with cosine-corrected optics simulating the human eye, anti-clipping features, extreme low-light accuracy, and integrated stray-light baffles. A VOA-160 portable camera-based system was also shown for track-side headlamp aiming.



STS emphasized its track testing as a service, managing setup, driving, teardown, and evaluation for customers, with hundreds of hours of ADB testing already performed.

In conclusion, STS showcased its ability to deliver fast, accurate, and fully automated FMVSS-108 ADB testing, backed by proven equipment and extensive track testing experience.

North American Lighting / SAE - “Status report SAE J3134™ Recommended Practice Automated Driving System (ADS) Marker Lamps”

Romeo Samoy

Mark provided a status update on SAE J3134, the Recommended Practice covering Automated Driving System (ADS) marker lamps. These devices indicate when a vehicle’s ADS is engaged, consistent with SAE J3016 definitions, which classify ADS as Levels 3, 4, and 5 of driving automation. Lower levels (0–2) fall under ADAS and are excluded.



SAE J3016™ LEVELS OF DRIVING AUTOMATION™

Learn more here: [sae.org/standards/content/j3016_202104](https://www.sae.org/standards/content/j3016_202104)

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	SAE LEVEL 0™	SAE LEVEL 1™	SAE LEVEL 2™	SAE LEVEL 3™	SAE LEVEL 4™	SAE LEVEL 5™
What does the human in the driver's seat have to do?	You <u>are</u> driving whenever these driver support features are engaged – even if your feet are off the pedals and you are not steering			You <u>are not</u> driving when these automated driving features are engaged – even if you are seated in “the driver’s seat”		
	You must constantly supervise these support features; you must steer, brake or accelerate as needed to maintain safety			When the feature requests, you must drive	These automated driving features will not require you to take over driving	

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The timeline of development began in December 2015, when automated driving lighting was first discussed in SAE Lighting Committee meetings. A task force was formed in 2016, and by November 2019, SAE J3134 was published. In April 2024, a Work in Progress (WIP) was opened, and by August 2025, the fifth ballot passed for the first revision, pending final approval and publication.

The current standard only covers front ADS marker lamps, but the upcoming revision expands to include rear and side marker lamps. This change reflects regulatory momentum:

A new UN ECE proposal with technical and installation requirements for front, side, and rear ADS marker lamps.

Proposed revisions to China’s GB standards to include front, side, and rear ADS lamps.

U.S. state law enforcement support for 360° ADS lamp visibility.

Evidence from vehicle test fleets already using front, rear, and side ADS lamps.

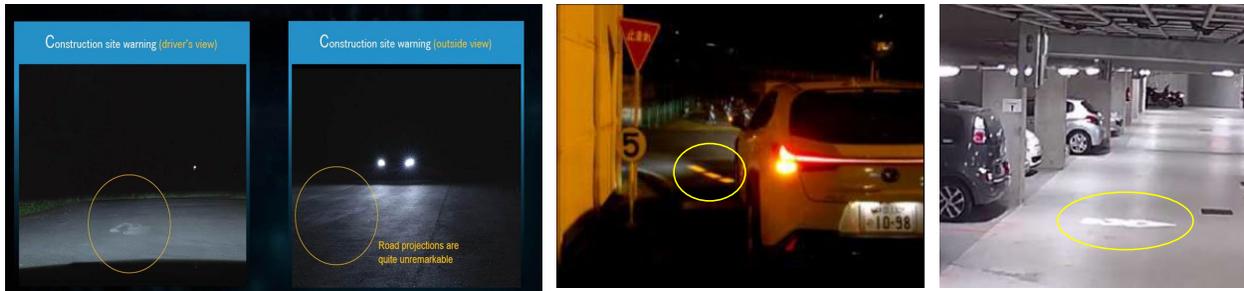
Mark mentioned that SAE J3134 remains the only established standard for ADS lighting, and its revisions are already influencing international harmonization of ADS lighting regulations.

SAE J3134 task force has advanced the industry’s first ADS lighting standard, with revisions now expanding beyond the front to include rear and side visibility, ensuring global regulatory alignment, safety, and clarity for road users in the era of automated driving.

Valeo / SAE - “SAE J3308 Driver Assistance Projections (DAP) & Signaling Road Projections (SRP) Overview & Update”

Mark Verplank

The presentation provided an update on SAE J3308, the recommended practice addressing Driver Assistance Projections (DAP) and Signaling Road Projections (SRP). These technologies project light patterns onto the road surface: DAP for information to the driver within the headlamp beam foreground, and SRP for patterned illumination that enhances recognition of specific signals for other road users and pedestrians.



The scope of SAE J3308 is to combine both projection types into a single recommended practice, originally intended to align with UNECE Regulation 149/48 for DAP and with the GTB proposal for SRP functions like turn signals and reversing lamps. Allowances were added for DAP to use symbols beyond those defined in UNECE Reg 149, offering flexibility for innovative applications.

The most recent updates specify that additional symbols and patterns may be permitted if they meet strict criteria:

- Must relate only to warning or highlighting hazardous traffic situations.
- Must emphasize the presence of road users requiring driver attention.
- Must support safe distance management and lane keeping.

	Slippery road warning	Activated when there is a risk of icy or snow covered roads		Pedestrian warning (three or more dots in a line extending from the center of the vehicle toward the detected pedestrian)	Activated when the vehicle detects a pedestrian within the lane markings in the direction of the pedestrian Flashing at 4.0 Hz +/- 1.0 Hz is allowed
	Risk of collision warning	Activated when vehicle speed is greater than 20 mph and risk of collision time is less than 1.4 seconds Flashing at 4.0 Hz +/- 1.0 Hz is allowed		Work zone warning	Activated when the vehicle enters a road construction zone
	Wrong way warning	Activated when the vehicle is entering a one way road or highway in the opposite direction of travel Flashing at 4.0 Hz +/- 1.0 Hz is allowed		Lane change indication	Activated during a change of lanes when initiated by an automatic system to show the intended direction of movement.
	Lane keeping assist and/or blind spot warning	Activated on the appropriate side of the vehicle if the vehicle unintentionally exits its lane of travel Activated when the turn signal is switched on and an object is detected in the blind spot		Predicted trajectory	Activated to show the predicted trajectory of the center of gravity of the vehicle. This shape may change following the pathway of the road.

The update also include a prohibition of red rear direction indicator projections, a restriction of SRP use to speeds below 40 km/h (25 mph), and recognition that at least one committee member raised legal concerns about DAPs.

Basic elements		Applicable function
Rectangle		Back-up projection
Chevron		Front, Rear and Side Direction indicator projection
<p>Note: Minor deviations from the shape of the basic elements when projected on the road, due to technical restrictions or environmental conditions are considered to comply with the shape of the basic elements.</p>		

The proposal is currently in its third round of balloting, reflecting ongoing discussion among stakeholders regarding its technical scope and regulatory implications.

SAE J3308 is shaping the framework for how road projections can be safely and effectively used as part of driver assistance and signaling, balancing innovation with safety and regulatory compliance in North America.

ams OSRAM / SAE - “GTB and GRE Update”
Bart Teburg

Bart summarized the latest developments from GTB (International Automotive Lighting and Light Signaling Expert Group) and the UNECE GRE (Working Party on Lighting and Light-Signaling). GTB brings together more than 150 experts from OEMs, lighting system and light source manufacturers, test laboratories, regulators, academia, and government bodies, across 17 member associations.

One major topic was lighting under parked conditions. Since January 2024, the Task Force on Lamps Under Parked Conditions (TF LUPC) has held seven meetings, with the next scheduled for September 25–26, 2025. Topics include the use of existing lamps with intensity limits, new

lamps such as charging indicators, defining time limits for activation, and preventing misinterpretation (e.g., backup lamps).

Car body lighting rules entered into force in January 2023, permitting only OEM logos up to 100 cm², centrally placed, and not integrated into stop, turn, or reversing lamps. A “small logo” restriction in RID functions is on the GRE-93 agenda (Oct 2025). GTB also referenced a research study by Fudan University and updates from SAE.

For road projections, UN regulations now cover driver assistance projections (effective Jan 2023) with limited symbols and patterns. In October 2024, lane guidance projections (“light carpet”) were added, constrained to vehicle width. Signaling road projections for back-up lamps were adopted in GRE-92 (Apr 2025), with turn signal projections scheduled for GRE-93 (Oct 2025). A live demonstration will take place at ISAL in Darmstadt (Sept 22–24, 2025).

The ADS marker lamp topic has resumed after being dormant since 2018. The Task Force on Autonomous Vehicle Signaling Requirements (TF AVSR) restarted discussions in April 2024 and has been drafting a stand-alone regulation with technical specifications and allowing contracting parties to opt out. The next meeting is scheduled for Sept 29, 2025.

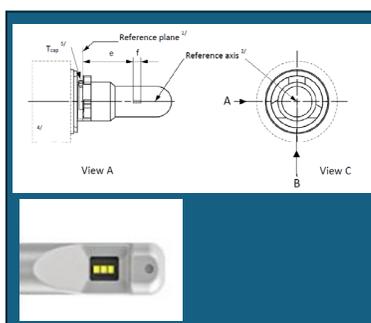
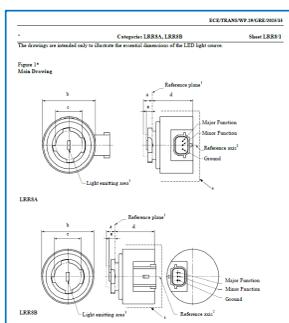


ADS Marker Lamp
Draft Regulation: ADS marker lamp → Draft technical characteristics (1/3)

DESIGNATED MARKER LAMPS FOR AUTOMATED VEHICLES	
Number	1
Deadline (m/yy/aa)	From: 01/2026 of From: 01/2026 of
Phenomenon (m/yy/aa)	From: 01/2026 of From: 01/2026 of
Height (m/yy/aa)	From: 1.20 of From: 1.20 of
Vertical (m/yy/aa)	From: 01/2026 of From: 01/2026 of From: 01/2026 of From: 01/2026 of
Geometric visibility (m/yy/aa)	From: 01/2026 of From: 01/2026 of From: 01/2026 of From: 01/2026 of
Mounting location (m/yy/aa)	From: 01/2026 of From: 01/2026 of From: 01/2026 of From: 01/2026 of
Length (m/yy/aa)	From: 01/2026 of From: 01/2026 of From: 01/2026 of From: 01/2026 of
Activation (m/yy/aa)	From: 01/2026 of From: 01/2026 of From: 01/2026 of From: 01/2026 of
Color (m/yy/aa)	From: 01/2026 of From: 01/2026 of From: 01/2026 of From: 01/2026 of

On light sources, GRE is phasing out obsolete filament types under Regulation 128, introducing LED dual-function red (tail/stop). LED replacement sources are advancing, with H11 LEDr adopted (Apr 2024) and H8, H16, and HB4 LEDr on the GRE-93 agenda (Oct 2025).

Glare prevention is another active area, with four GRE task force meetings held in 2025 and eight GTB meetings since mid-2024.



GRE-TF on “Glare Prevention”

DVN “Glare Forum”
8 September 2025

Laurel Manor
Livonia, Michigan, USA

Dr. Bart TERBURG
GTB Vice-President
(on behalf of GRE-TF Co-Secretariat)

<https://wiki.unece.org/x/vglzDw>

Bart mentioned the upcoming meetings in September 15–19 (working group sessions online), and November 17–21 (plenary and working group sessions, Ljubljana, Slovenia) in 2025.



The update focused on progress in park condition lighting, car body logo rules, road and ADS projections, LED retrofit sources, and glare prevention, showing how GTB and GRE are shaping harmonized international standards for automotive lighting.

SESSION 4: EE ARCHITECTURE

Infineon - “How Infineon’s smart LED drivers enable software-less architectures in automotive lighting”

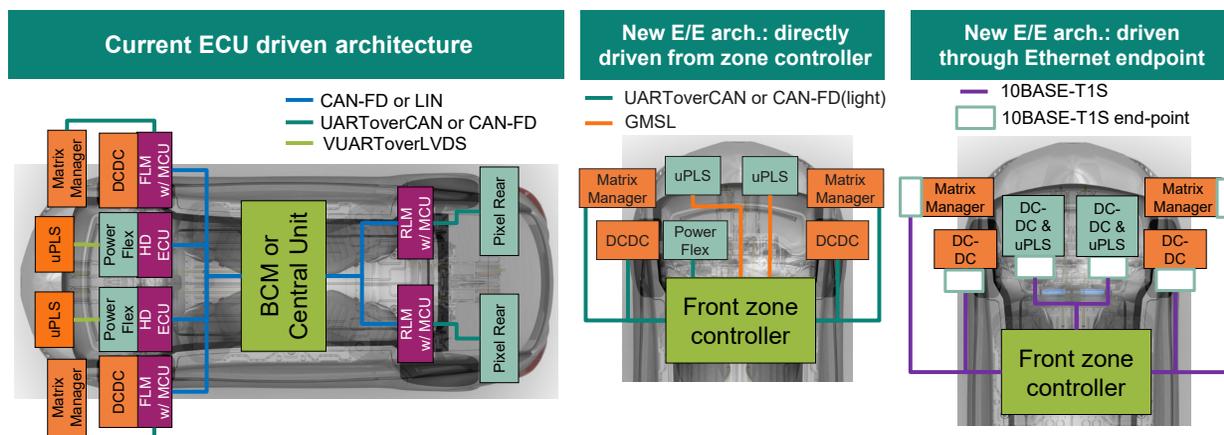
Nestor Bazan

Infineon presented its strategy for how smart LED drivers can support the industry’s transition toward software-less architectures in automotive lighting. LED technology now drives new value across the lighting value chain, enabling integration of lighting ECUs into zone controllers, reduction of wiring harness complexity, and elimination of microcontrollers from lamp ECUs.

These changes align with evolving zone-oriented E/E architectures, expected after 2027/2028, where software will migrate from individual lamps into zone controllers. Smart LED drivers or gateways are essential in this evolution, enabling control, diagnostics, and safety functions (ASIL B compliance, ISO 26262). Applications include adaptive driving beam, road projections, animated rear lamps, and illuminated grilles with high pixel counts.

Nestor described the transition from today’s ECU-driven architectures to new approaches:

- Current model: each light function (DRL, fog, low/high beam, etc.) has its own ECU, connected via CAN-FD or LIN.
- New model: ECU functions are split between smart LED drivers (with bus interfaces) and zone controllers, or managed entirely by zone controllers via Ethernet endpoints (10BASE-T1S).



Communication protocols play a central role. UART-over-CAN is widely accepted as it supports both direct control and Ethernet gateway solutions. Infineon outlined two options: direct zone controller-driven control for lowest cost, or Ethernet endpoint-driven control with higher flexibility but added gateway costs.

UART-over-CAN is widely accepted by major OEMs, as it serves both options either with direct control or through Ethernet gateway

Infineon Infineon offers a wide portfolio for automotive lighting applications - We enable SW-less transition with our UART/SPI/LIN based portfolio **Infineon**

Today: driven from ECU to implement animations

- Legend: CAN-FD or LIN (blue), UARToverCAN or CAN-FD(Light) (green), UARToverCAN (teal), LED driver (grey).
- Diagram: BCM or Central Unit (i.e. Zone Controller) connects to ECU, which then controls LED drivers.

Option 1: directly driven from Zone Controller

- Legend: UARToverCAN (teal), LED driver (grey).
- Diagram: Central Unit (i.e. Zone Controller) connects directly to LED drivers.
- PRO: Lowest cost solution, No ECU or gateway needed, No royalty fees for IPs.
- CON: Dedicated support for custom interface needed, Difficult to mix different IC's on the same bus.

Option 2: driven through Ethernet Endpoint

- Legend: UARToverCAN (teal), 10BASE-T1S (purple), Gateway for transition (orange), LED driver (grey).
- Diagram: BCM or Central Unit (i.e. Zone Controller) connects to LED drivers via a Gateway for transition.
- PRO: Ethernet px addressing, Mix different ICs on endpoint.
- CON: Required Gateway incur higher cost.

Infineon LED Driver Portfolio: A circular diagram showing various ICs and their interfaces for different lighting applications:

- Turn Indicator: LITIX™ Linear, LITIX™ Basic, LITIX™ Power, LITIX™ Pixel Rear.
- Tail light: LITIX™ Linear, LITIX™ Basic, LITIX™ Power, LITIX™ Pixel Rear.
- Blind-spot light: LITIX™ Linear, LITIX™ Basic, LITIX™ Power, LITIX™ Pixel Rear.
- Interior light: LITIX™ Linear, LITIX™ Basic, LITIX™ Power, LITIX™ Pixel Rear.
- Low beam: LITIX™ Linear, LITIX™ Basic, LITIX™ Power, LITIX™ Pixel Rear.
- High beam: LITIX™ Linear, LITIX™ Basic, LITIX™ Power, LITIX™ Pixel Rear.
- DRL: LITIX™ Linear, LITIX™ Basic, LITIX™ Power, LITIX™ Pixel Rear.
- Fog light: LITIX™ Linear, LITIX™ Basic, LITIX™ Power, LITIX™ Pixel Rear.
- HD ADB: LITIX™ Linear, LITIX™ Basic, LITIX™ Power, LITIX™ Pixel Rear.

Infineon showed its broad portfolio of UART, LIN, and SPI-based LED driver ICs, covering a full range of functions from blind-spot and turn indicators to interior lighting, fog lamps, and HD adaptive driving beam. These solutions allow OEMs to support both current ECU-based architectures and next-generation zone controller-driven designs.

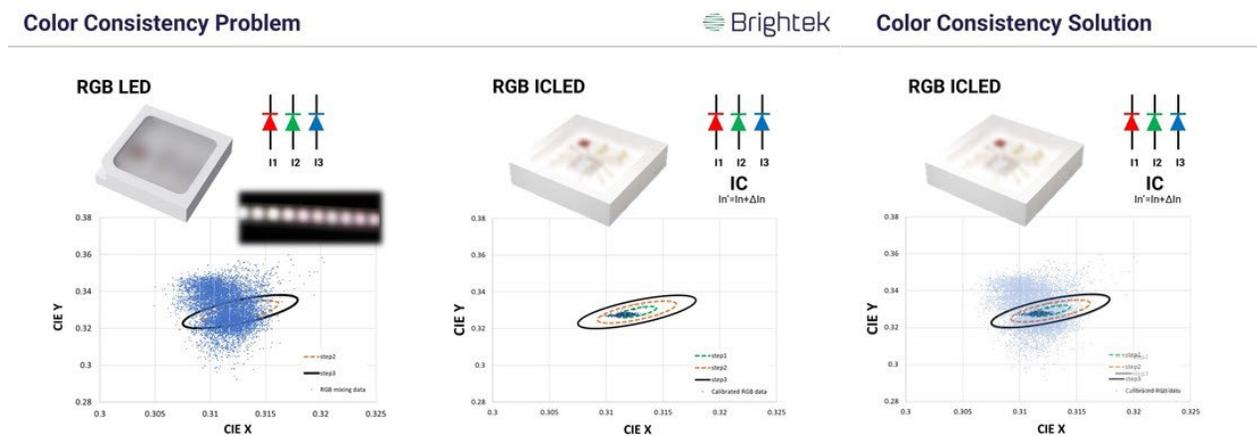
Infineon showed that it is a trusted semiconductor partner enabling the transition to software-less automotive lighting architectures, ensuring flexibility, safety, and cost efficiency across legacy and future E/E systems.

Brightek - “A Smart Lighting Solution for MCU-Less Automotive Systems”

Dr David Chen

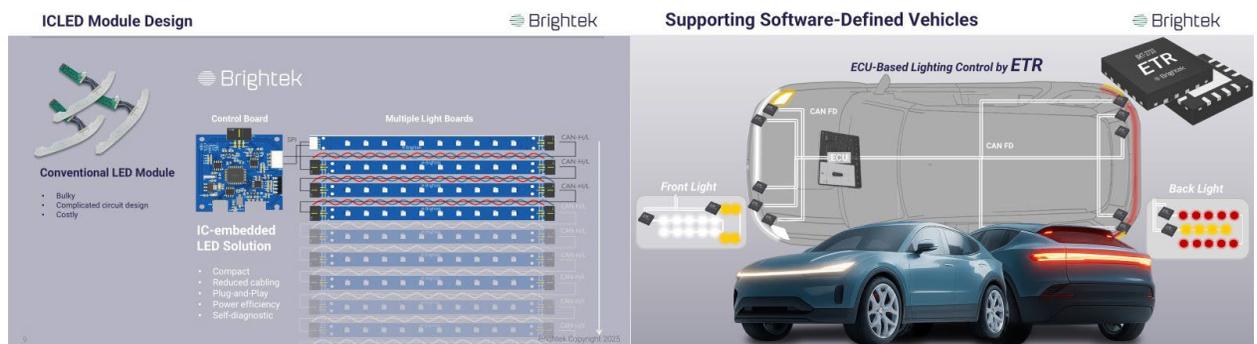
Brightek presented its approach to simplifying automotive lighting systems through MCU-less architectures enabled by ICLED technology. Conventional lighting designs, with separate modules and microcontrollers, are bulky, complicated, and costly. In contrast, Brightek’s IC-embedded LED solution creates compact, efficient, and inexpensive systems with improved cooling and reduced cabling.

Founded in 2001 and listed on the stock exchange in 2021, Brightek is headquartered in Taiwan with manufacturing sites in China and India (from 2027). Its product applications span 40% automotive and 60% consumer electronics and sensing, supported by innovations in LED emitters and driver ICs.

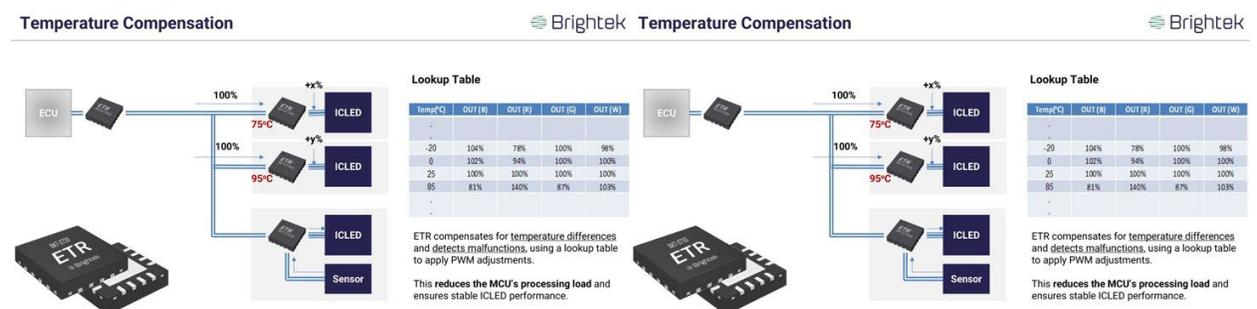


At the core of this solution is the ICLED System-in-Package (SiP), which integrates PWM driver ICs with RGB LEDs, allowing direct command-based control of each LED. This design solves the color consistency problem inherent in conventional RGB LED systems.

Brightek also introduced the ETR (Enhanced Transmission & Regulation) system, which bridges SPI, I²C, and CAN FD communication for seamless integration of controllers, sensors, and smart LEDs. ETR supports OTP addressing of up to 31 slaves, broadcast functions, temperature compensation, and overheat protection. This reduces ECU dependency and simplifies circuits while maintaining stable ICLED performance.



Benefits include superior color consistency, 30% cost savings, 40% board space reduction. ETR also enables longer-distance connections (up to 10 m), faster transmission (up to 5 MB), and scalability to 62 light strips.



Applications range from smart interior ambient lighting (ICLED 3535, 5525 side-view, dual 2720 LEDs) to advanced exterior solutions, with modules tailored for amber, white, and RGB control. Brightek also offers LIN-Lite single-LED and LIN-RGB modules for compact EV applications, combining ICLEDs with heat-dissipating metal plates.



Brightek positioned its ICLED + ETR platform as a scalable, efficient, and cost-effective smart lighting solution that eliminates MCUs, simplifies design, and delivers both functional and aesthetic value for next-generation automotive systems.

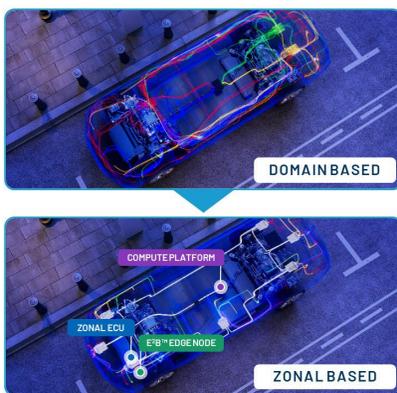
Analog Devices - “Evolving Architectures of Headlamps in SDV”

Ron Ocampo

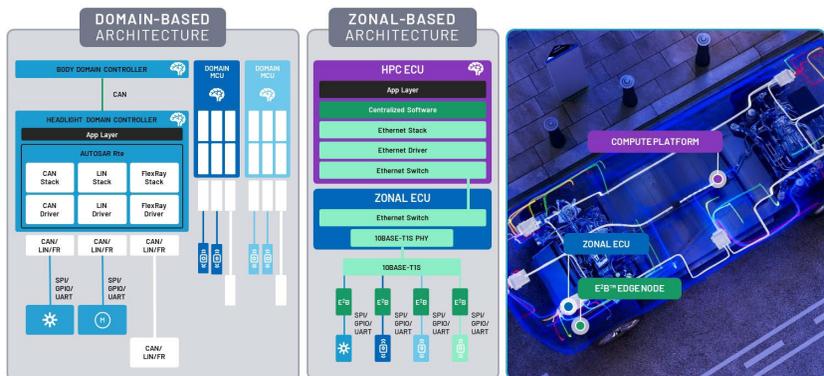
Analog Devices presented its vision for how headlamp architectures are evolving in the era of software-defined vehicles (SDVs). The transition is moving from domain-based architectures—where microcontrollers manage local lamp functions—to zonal-based architectures with centralized software control.

In zonal architectures, E²B edge nodes connect to zonal ECUs through 10BASE-T1S Ethernet, eliminating the need for multiple MCUs and memory inside headlamps, reducing system cost, simplifies software qualification, and facilitate over-the-air updates. Lighting control and animation data are centralized, while gPTP synchronization ensures precise timing across the system by reduction of complexity.

Centralizing Software in the SDV Era



Zonal Architecture with Centralized Software



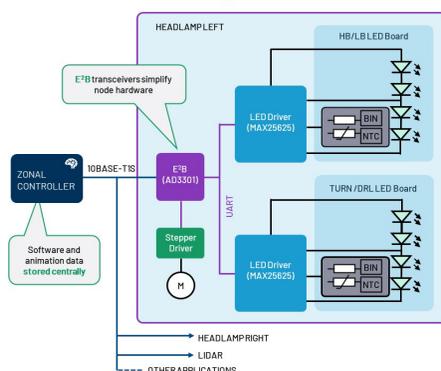
Ron described how MCU-less headlamps can be realized by centralizing all software in the zonal controller. Hardware-only headlamps, equipped with E²B™ transceivers, simplify node design and support applications beyond lighting, such as LiDAR integration.

Analog Devices also detailed its automotive lighting solutions portfolio. Key components include: 10BASE-T1S E²B™ RCP Transceivers, providing deterministic, low-latency communication with time-stamping and timed actuation.

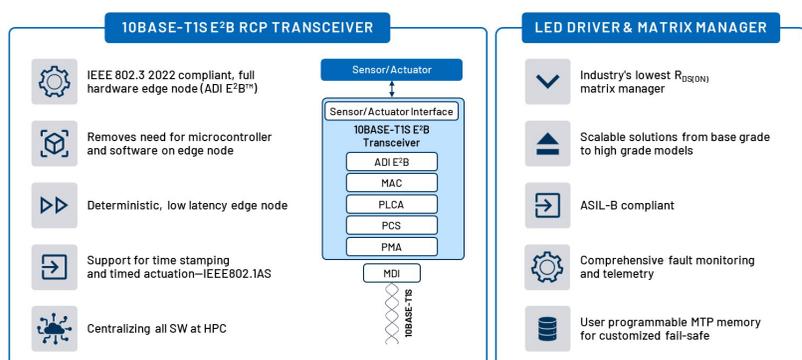
LED drivers and matrix managers, with the industry’s lowest RDS(on), supporting scalable solutions from base-grade to high-grade models.

ASIL-B compliance for functional safety, comprehensive fault monitoring, telemetry, and user-programmable MTP memory for fail-safe customization.

MCU-less Headlamp Enabling SDV



ADI Automotive Lighting Solutions



Analog Devices showcased how centralizing software and simplifying edge hardware with E²B™ technology enables cost reduction, functional safety, and flexibility in SDVs, while preparing headlamp systems for advanced applications in the future.

Microchip - “Lighting the Edge: Strategies in Software-Defined Vehicles”

Ron Sven Semmler

Microchip presented their perspective on how software-defined vehicle concepts are reshaping automotive lighting, drawing parallels to smartphones that can change behavior and add features through software and over-the-air (OTA) updates. This approach positions lighting as a remotely controlled hardware system, enabling reduced cost and complexity and increase in flexibility.

Ron contrasted this with the MCU-less edge architecture, where software stacks, field updates, and complex verification processes are eliminated. By removing microcontrollers at the lamp edge, systems reduce cybersecurity risks, minimize attack surfaces, and rely instead on authentication and centralized control.

An incremental approach was emphasized, showing how lighting endpoints can progressively shift from distributed software-driven modules toward centrally managed, remotely controlled hardware. This ensures a smooth migration path while maintaining compatibility and scalability.



Communication frameworks such as SOME/IP support these architectures, enabling efficient data exchange between zone or central controllers and lighting endpoints.

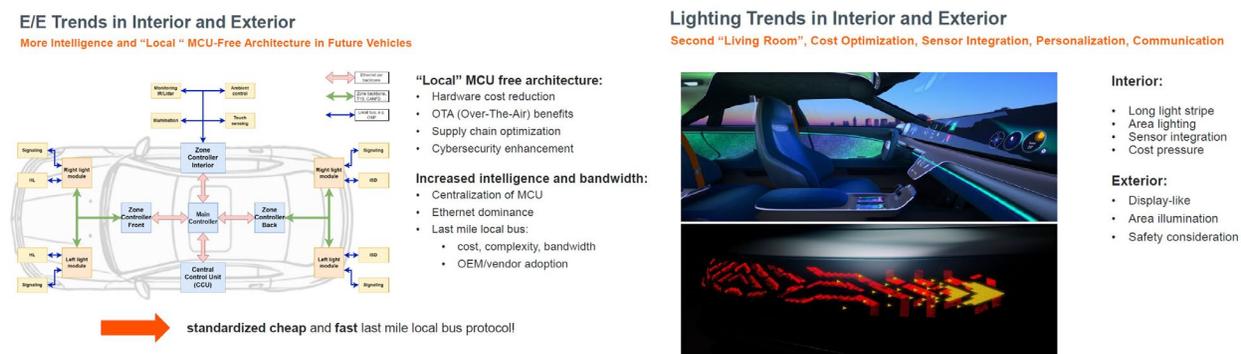
Microchip positioned MCU-less edge designs and centralized computing as the foundation for the next stage of automotive lighting. By eliminating redundant edge software, reducing cybersecurity vulnerabilities, and enabling OTA-driven adaptability, the company envisions lighting systems that are simpler, safer, and more cost-effective for software-defined vehicles.

ams OSRAM - “Open System Protocol drivers to bring exterior lighting to life”

Lufei Shen

ams OSRAM presented its work on Open System Protocol (OSP) drivers and how they are shaping the future of vehicle lighting. The company identified key industry trends driving innovation: ECU-free architectures, greater pixelation with more light points, dynamic lighting requiring fast communication, and the growing role of personalization, safety, and cost optimization in both interior and exterior applications.

The shift to MCU-free architecture offers benefits in reduced hardware cost, OTA update capability, supply chain efficiency, and enhanced cybersecurity. This is supported by the move toward centralized controllers with Ethernet dominance, while still requiring a cheap, fast, and standardized “last mile” protocol to connect lighting nodes.



The OSP ecosystem was highlighted as an open, growing platform supported by semiconductor suppliers and standardized efforts (ISO). Resources such as evaluation kits, GitHub repositories, and technical support are available to encourage adoption.

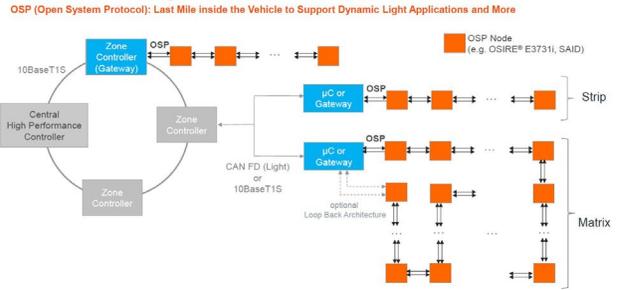
Integration into E/E vehicle architectures shows OSP nodes such as OSIRE E3731i or SAID devices connected through zone controllers via CAN FD or 10Base-T1S. Configurations include

daisy chains of up to 1000 nodes or parallel architectures for cost-effective and robust area lighting.

OSP (Open System Protocol) for Dynamic Lighting and More
 A Growing Open (Free) Ecosystem with More Members!

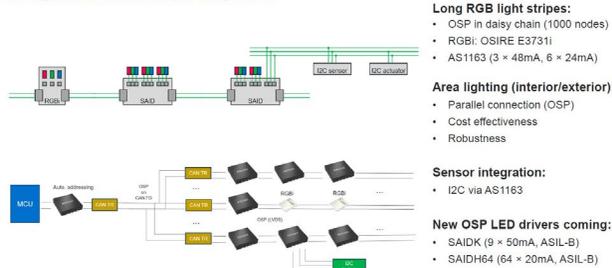


OSP E/E Vehicle Integration

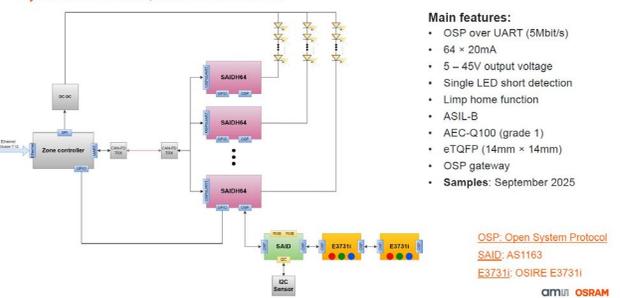


Among the product highlights, the Stand-Alone Intelligent Driver (SAID AS1163) supports long RGB light stripes and integrates sensors via I²C, while new drivers such as SAIDK and SAIDH64 (ASIL-B compliant) expand current capacity and applications. The SAIDH64 AS1190 supports segmented mini-LED arrays with OSP over UART at 5Mbit/s, providing high reliability and diagnostics.

Stand-Alone Intelligent Driver SAID AS1163
 Serving Increased Number of Dynamic Light Points



SAIDH64 AS1190 Typical Applications (Segmented Mini-LED Arrays)
 Physical: UART over CAN; Protocol: OSP over UART



Lufei concluded with a vision of innovation through openness, emphasizing OSP as a key enabler for dynamic lighting, extended light stripes, area illumination, sensor integration, and safety. Demonstrations included the SAID Lyra midpower LED and an OSP exterior demonstrator with KURZ.

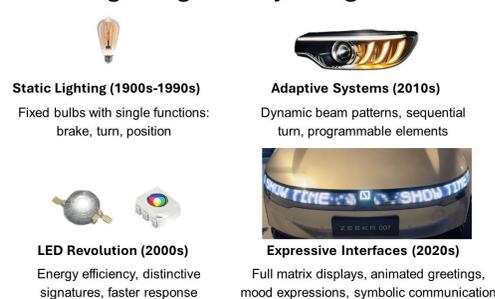
ams OSRAM showed how OSP drivers and open ecosystems as the pathway to scalable, cost-effective, and intelligent automotive lighting architectures that align with the industry’s move toward ECU-free, software-defined vehicles.

Lumissil Microsystems - “Intelligent Signal Displays & Communication Lighting: Communicating Safety and Style Through Automotive Lighting”
 Aaron Reynoso

Aaron Microsystems presented the evolution of automotive lighting from static bulbs of the 1900s, to the LED revolution of the 2000s, the adaptive systems of the 2010s, and now the expressive interfaces of the 2020s, full matrix displays with animated greetings, mood expression, and symbolic communication.

At the center of this vision is the Intelligent Signal Display (ISD), which enhances safety communication through clearer intent signals, provides autonomous state visualization, supports brand differentiation via unique light signatures, and enables human-machine interaction with pedestrians, cyclists, and other drivers.

From Signaling to Storytelling



Concept of ISD is NOT New



A case study in robotaxis showed ISDs guiding rider operations and curbside flow through pickup/drop-off prompts, rider identification codes, and animations signaling pedestrian intent

The concept is not new—examples include Audi’s Swarm (2013) and Toyota’s Fun VII (2011)—but regulatory frameworks vary globally. China has created space for experimentation, Europe has evolved to allow some expressive elements, while the U.S. remains more conservative.

ISDs are gaining momentum through expressive lighting signatures. Examples include Audi’s sequential turn signals and welcome sequences, BMW’s illuminated grilles and dynamic “Angel Eyes,” and Rivian’s charge status bar with animated green indicators

Behind these applications are innovative LED driver technologies. Lumissil demonstrated EMI-reduction techniques such as PWM phase delay and dithering at >20–32 kHz to eliminate flicker, camera artifacts, and coil hum, while improving compliance with CISPR-25/32 standards.

Specific ISD solutions include:

- IS32FL3776: 36×6 (216 LEDs), >20 kHz PWM, 10-bit ADC, with external FETs for thermal management.
- IS32FL3761: 33×12 (396 LEDs), 12-bit PWM with dithering, 24 kHz scan, spread spectrum, ghost removal.
- IS32LT3138A / 3136: high-channel drivers for LEDs (18 ch @100 mA) and OLEDs (32 ch @35 mA).

Lumissil showed how Intelligent Signal Displays transform lighting from signaling to storytelling, merging safety, regulation, brand identity, and expressive design into a unified system for the next era of mobility.

SESSION 5 : LIGHTING AND SAFETY

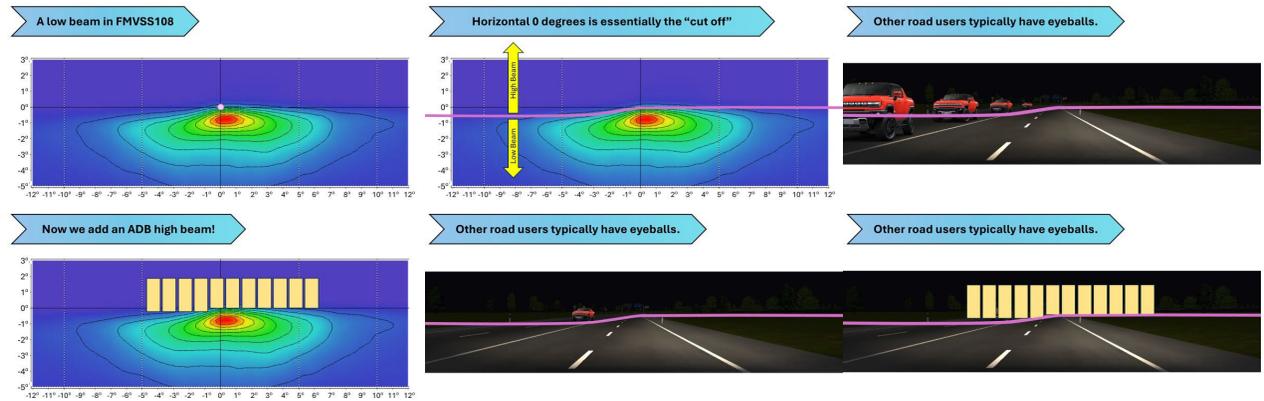
General Motors - “Headlamp Ratings and Optics”

Jodi Allen

Jodi examined the interaction between Adaptive Driving Beam (ADB) requirements under FMVSS108 and Automatic Emergency Braking (AEB) requirements under FMVSS127.

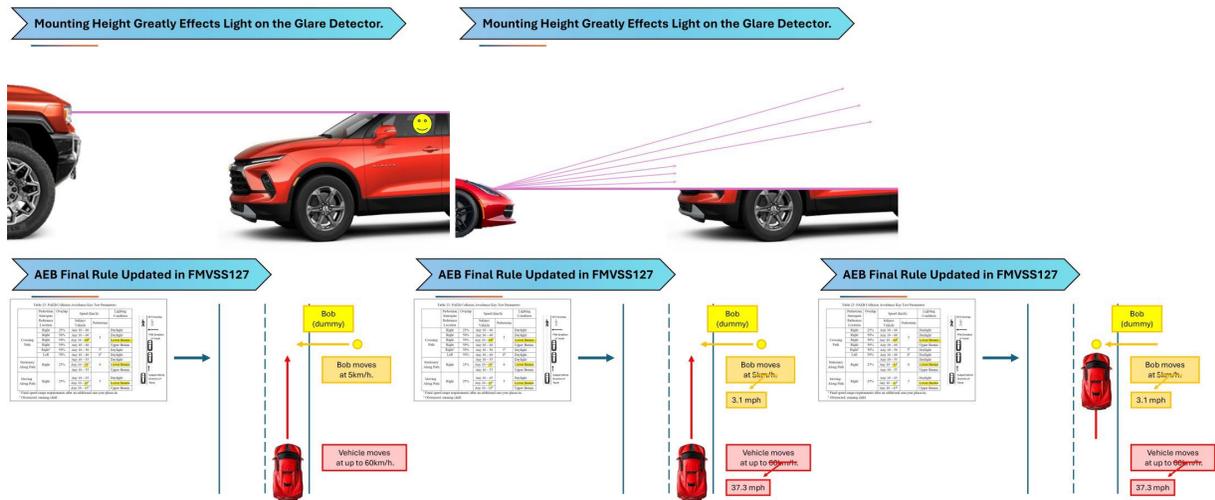
FMVSS108 defines low and high beam distributions, with horizontal 0 degrees representing the beam cutoff. ADB systems add complexity by dynamically controlling high beams to avoid glare for other road users—who “typically have eyeballs,” as the presentation humorously noted.

The key challenge is glare management. Mounting height strongly influences how much light reaches glare detectors and road users, affecting ADB performance.

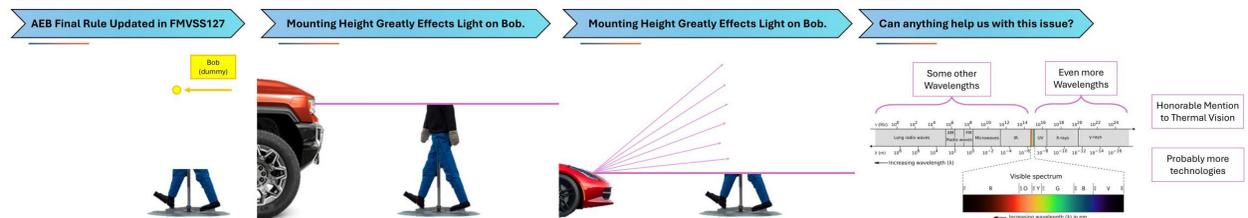


FMVSS127 introduces AEB requirements, evaluated with pedestrian dummies (“Bob”) moving at 5 km/h, while vehicles travel up to 60 km/h. Unlike ADB, which favors low-mounted, downward beams, AEB relies on high-mounted, upward-facing sensors and illumination to ensure pedestrian detection.

This creates a regulatory conflict: ADB requires controlling upward light to prevent glare, while AEB demands upward light to detect and avoid hitting pedestrians. The presentation asked: “Do these regulations conflict?” and highlighted the need for solutions that balance the two requirements.



Potential paths forward include exploring other wavelengths (infrared, thermal vision, or additional spectral bands), as well as improving precision and prediction of upward light intensity. These advances could help reconcile regulatory needs without compromising safety or driver comfort.

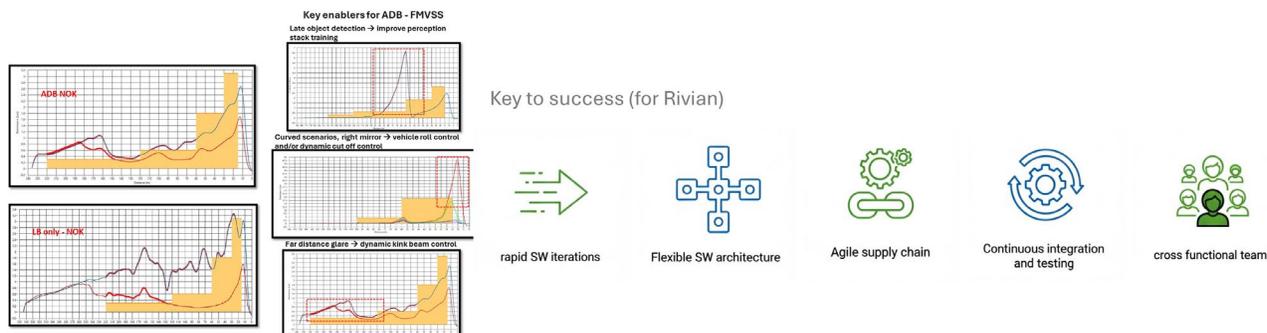


In conclusion, the key takeaway emphasized by Jodi was clear: the industry must solve the issues of upward light intensity management to align ADB and AEB regulations, ensuring both glare prevention and effective pedestrian protection.

Rivian - “Rivian ADB fist to US market”

Carlos Montes Relanzon

Rivian shared its journey in adapting Adaptive Driving Beam (ADB) technology for the North American market, starting with lessons learned from its European ADB prototype. Initial evaluations revealed limitations: low beam-only setups were not acceptable, ECE-based optical designs required extensive rework, and factors like vehicle height, roll, and pitch proved critical. Equally important was the role of the camera and perception stack in ensuring timely and accurate control of glare and illumination.

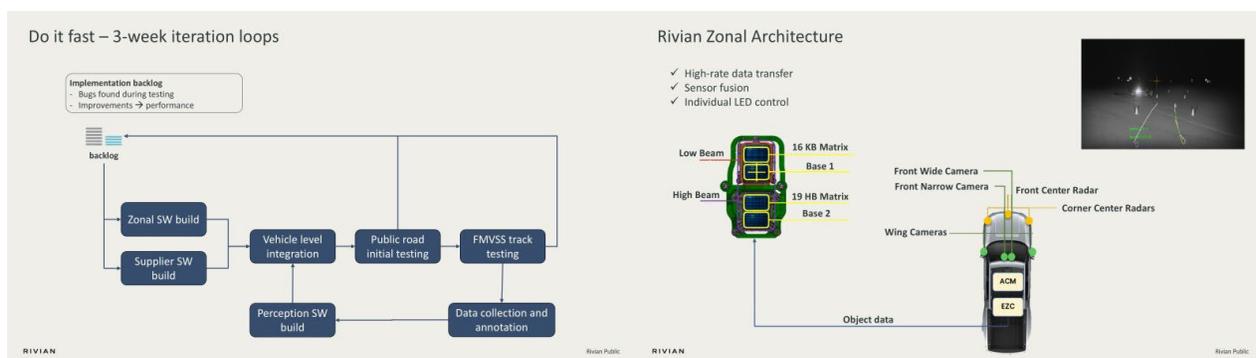


To meet FMVSS requirements, Rivian identified several key enablers:

- Improved perception stack training for earlier object detection.
- Dynamic cut-off control to manage roll and curved scenarios.
- Dynamic kink beam control to handle far-distance glare.

Carlos stressed that rapid software iteration cycles were essential. During key design phases, Rivian implemented bi-weekly software builds and three-week iteration loops spanning zonal software builds, supplier builds, vehicle-level integration, public road tests, and FMVSS track validation.

This approach required a flexible electronics architecture based on zonal design, which allowed reallocation of functionality as needed. It also relied on close collaboration with agile suppliers—moving away from traditional A/B/C sample phases—and continuous cross-functional teamwork across lighting, homologation, software, and E/E hardware engineering.



Rivian’s zonal architecture integrates high-rate data transfer, sensor fusion, and individual LED control across a matrix lighting system with 19 HB and 16 KB modules, coordinated with base low and high beams.

Carlos highlighted that the success of ADB for North America depends on combining advanced perception systems with agile software development, zonal electronics, and robust cross-team collaboration, ensuring glare-free illumination that meets both regulatory and customer expectations.

Marelli - “Infrared support for future AEB systems”

Colby Childres

Marelli presented its work on lighting solutions to support pedestrian Automatic Emergency Braking (AEB) in line with new FMVSS 127 requirements finalized in April 2024 and upcoming NCAP 2026 protocols. All new vehicles must meet AEB standards by September 2029, with pedestrian scenarios tested both day and night.

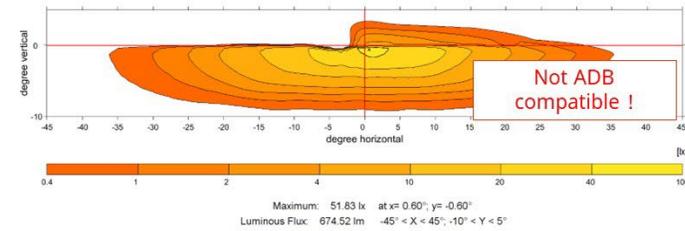
The test dummies used in FMVSS 127 have specific optical properties: high reflectance on face and hands, low reflectance on jackets, and strong blue reflectance on trousers. Vehicles with LED headlamps may gain an advantage in detecting blue trousers compared to halogen systems.

However, typical SAE low beam distributions illuminate only about half of the pedestrian, leaving detection gaps.

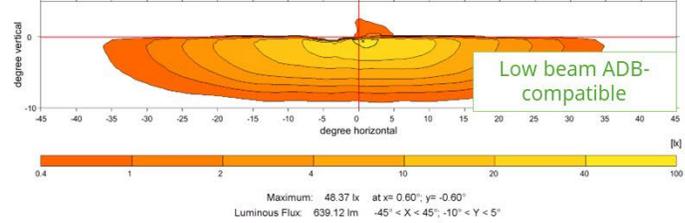
A key challenge arises between FMVSS 127 and FMVSS 108 Adaptive Driving Beam (ADB) rules. To maximize pedestrian detection, FMVSS 127 favors upward light, while ADB regulations restrict upward light to prevent glare. Compatible low beams deliver "GOOD" IIHS ratings but limit pedestrian illumination, whereas optimized FMVSS 127 low beams enhance detection but are not ADB-compatible.

Lighting for pedestrian AEB
How much light is possible?

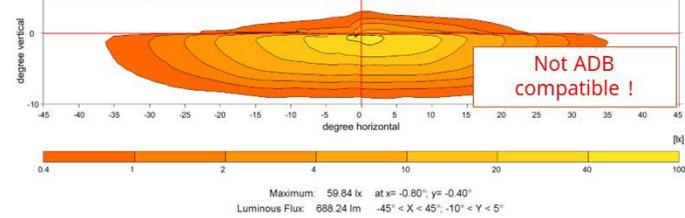
Low beam optimized for FMVSS 127



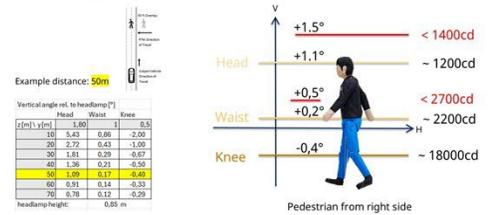
Low beam ADB-compatible



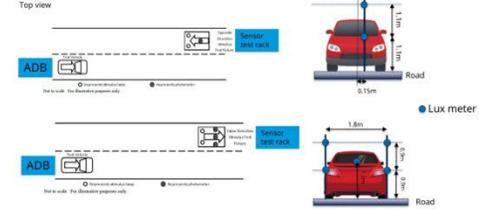
Low beam optimized for NCAP 2026



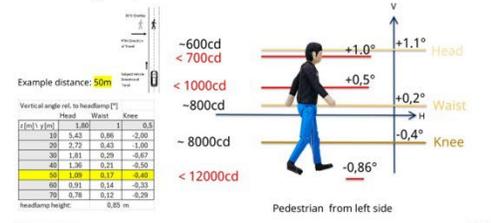
Lighting for pedestrian AEB
How much light is possible?



Lighting for pedestrian AEB
FMVSS108 Adaptive Driving Beam (ADB)

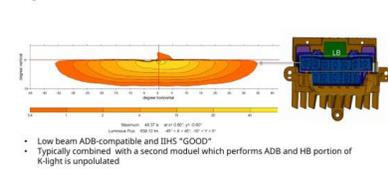


Lighting for pedestrian AEB
How much light is possible?

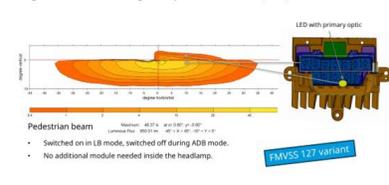


NCAP 2026 introduces additional night scenarios, including pedestrians approaching from the left. Again, maximizing light and torso illumination increases detection but risks higher glare levels.

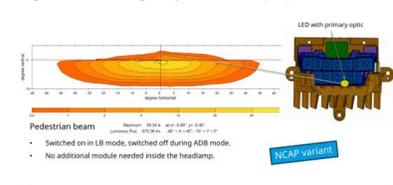
Lighting for pedestrian AEB
K-Light Module



Lighting for pedestrian AEB
K-Light Module with integrated pedestrian beam (VIS)

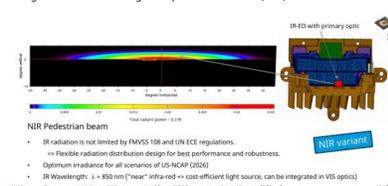


Lighting for pedestrian AEB
K-Light Module with integrated pedestrian beam (VIS)

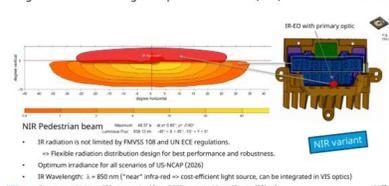


Marelli's proposed technical solution is the K-Light module with integrated pedestrian beam. In the FMVSS 127 and NCAP visible-light variants, the pedestrian beam switches on during low-beam mode and off during ADB mode, requiring no extra modules inside the headlamp. A near-infrared (NIR) variant was also introduced, emitting at 850 nm to avoid FMVSS 108/UNECE limits and deliver optimal irradiance across NCAP scenarios. This requires compatible RCCB sensors without IR cut-off filters.

Lighting for pedestrian AEB
K-Light Module with integrated pedestrian beam (NIR)



Lighting for pedestrian AEB
K-Light Module with integrated pedestrian beam (NIR)

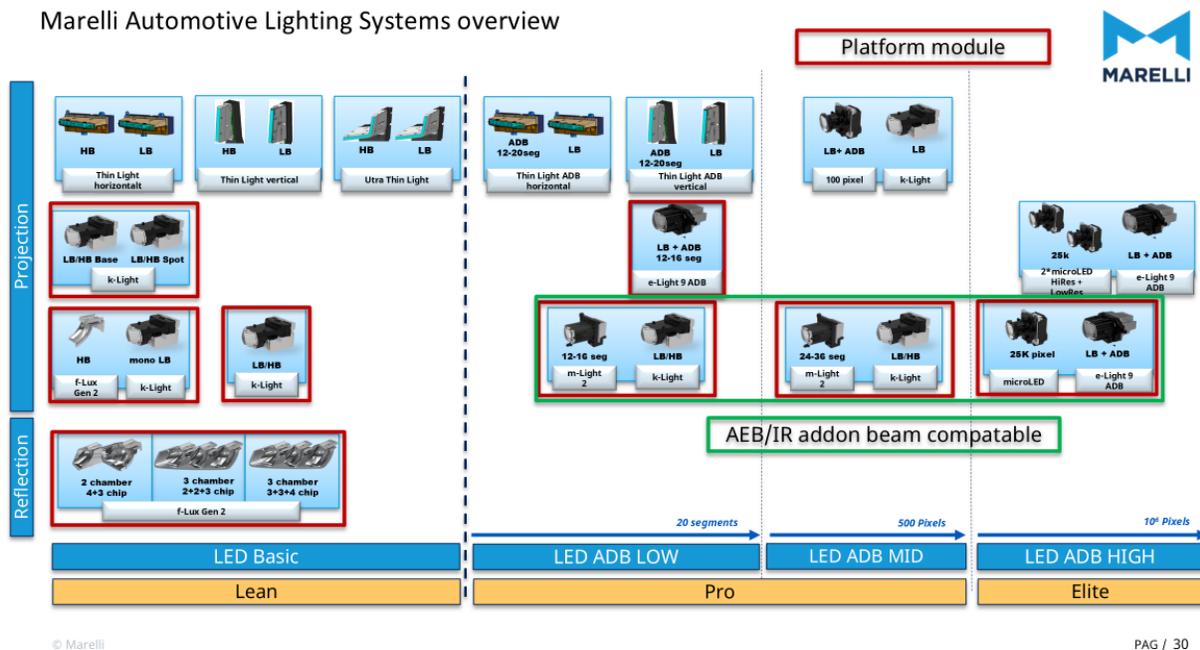


Lighting for pedestrian AEB
Summary

	FMVSS 127 support	NCAP 2026 support	ADB compatible	Low glare of low beam	IIHS "GOOD" compatible
Low beam ADB-compatible	X	X	X	✓	✓
Low beam optimized for FMVSS127	?	??	X	X	✓
Low beam optimized for NCAP	?	??	X	X	✓
Low beam + switchable NCAP support beam (VIS)	?	??	X	X	✓
Low beam + pedestrian beam (NIR)	?	??	X	X	✓

Finally, Marelli outlined its lighting system portfolio, ranging from basic LED to advanced projection ADB with 500 to over a million pixels. The K-Light pedestrian beam can be added across these platforms to meet both AEB and ADB requirements.

Marelli Automotive Lighting Systems overview



In summary, Marelli positioned its K-Light pedestrian beam technology, in both visible and NIR forms, as a practical path to reconcile AEB detection needs with ADB glare limits, ensuring safety, compliance, and scalability across vehicle platforms.

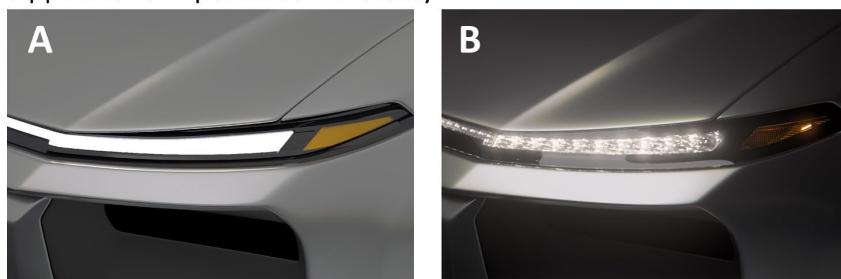
Ansys - “Virtual Prototypes for Appearance Validation of Lighting”

Victor Loya

Ansyes highlighted how virtual prototypes are transforming the way automotive lighting appearance is validated. Lighting today is not only a safety feature but also a brand signature and selling factor, making aesthetics as critical as photometric performance. With increasingly complex optical systems, predicting appearance has become difficult, reinforcing the need for predictive renderings.

Victor explained why appearance matters: it drives perceived quality, customer loyalty, ratings, and warranty claims, while also reflecting design complexity in terms of components, weight, manufacturability, and cost. Additionally, lighting communicates efficiently as a signaling device and supports V2X interaction.

Appearance Expectation vs Reality

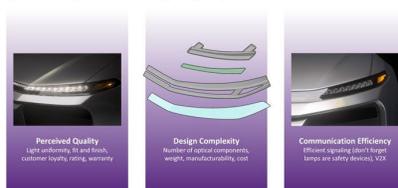


Appearance Facts



Ansyes showcased how Speos simulation renderings differ from CGI or Photoshop. By combining photon data with human vision models, these renderings capture factors such as eye dynamic range, glare adaptation, depth of field, legibility, visibility, and observer age.

Why is the Appearance of Lighting Important?

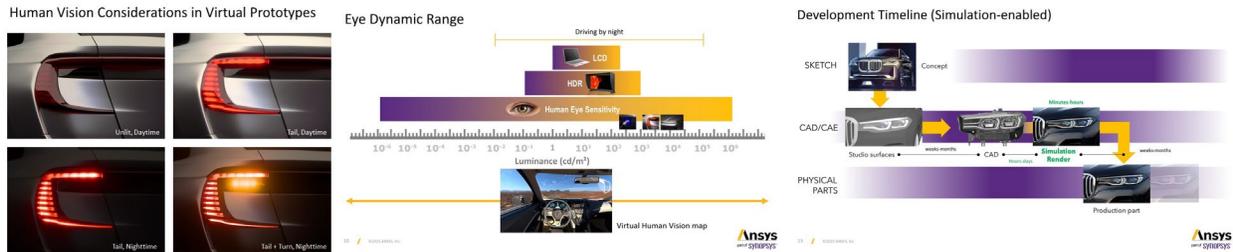


Advantages of Simulation Renderings

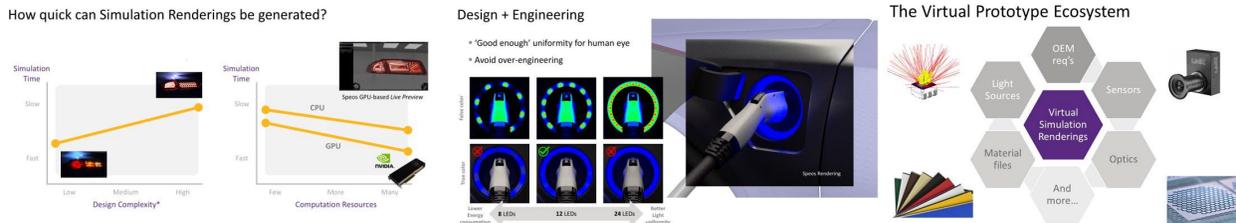
Two main features make a Speos simulation result different than other tools' renderings:



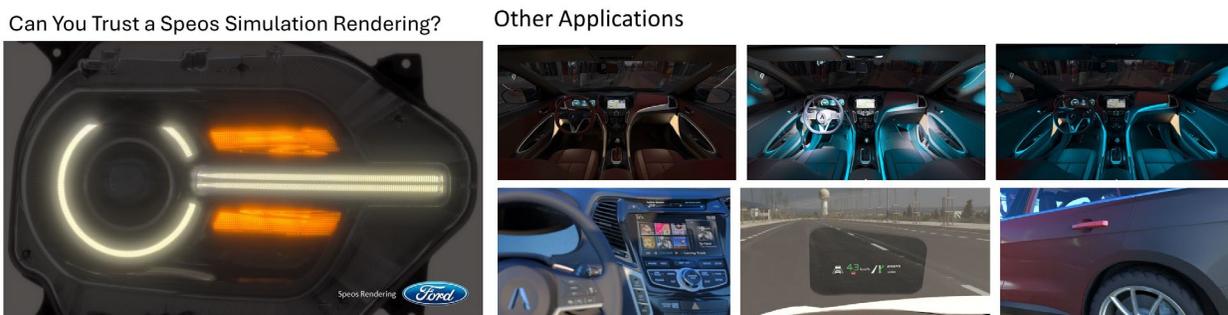
Examples of simulation results compared tail lamps under different conditions, day vs. night, lit vs. unlit, and combined functions like tail + turn, demonstrating how virtual human vision maps provide a truer representation of perception than linear photometric maps.



Victor contrasted traditional development timelines, where prototyping takes weeks to months, with simulation-enabled timelines, where renderings can be generated in hours or even minutes. GPU-based live previews accelerate iteration, balancing speed and accuracy by adjusting ray count, resolution, meshing, and optical parameters.



Simulation also helps avoid over engineering by evaluating uniformity and energy consumption across different LED configurations (e.g., 8 vs 12 vs 24 LEDs), engineers can optimize for both perceived quality and efficiency.



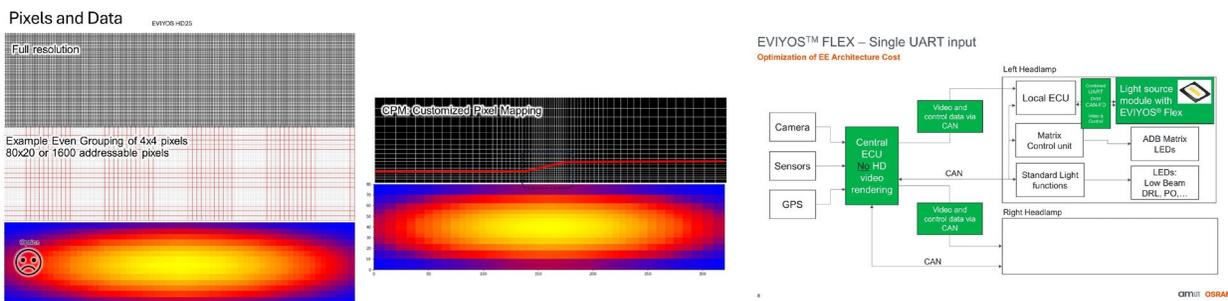
Victor highlighted that Speos virtual prototypes form an ecosystem trusted for diverse applications: interior lighting, displays, HMIs, HUDs, vision ergonomics, and design aesthetics.

Ansys positioned virtual prototypes as a faster, more reliable, and perception-based method to validate lighting appearance, bridging design and engineering, while reducing cost, time, and risk.

ams OSRAM - “Freedom of choice in ADB resolution: EVIYOS Flex and the new OSLON PX”
Joe Jablonski

Joe introduced the EVIYOS® micro-structured LED chip, first developed as a 25,600-pixel monolithic light source. Honored with the German Future Award, it has since been deployed in production vehicles worldwide. Ams OSRAM continues to expand the portfolio, offering variants optimized for different vehicle platforms.

EVIYOS 2.x delivers high-resolution lighting with an aspect ratio of 1:4, 25,600 individually addressable pixels, contrast >1:240, typical luminance of 90 MNits, and integration of LED/IC hybrid plus companion ASIC. Customized Pixel Mapping (CPM) enables flexible pixel groupings such as 4x4 clusters (1,600 pixels) or full resolution (25,600 pixels).

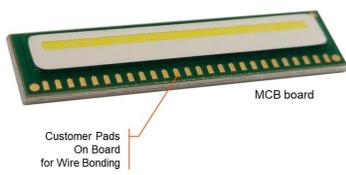


The new EVIYOS FLEX variant supports simplified integration with a single UART input and optimized cost structures. Architectures can be designed with a central ECU rendering HD video, distributing data via high-speed links, or with more localized matrix control.

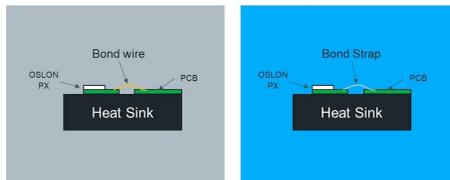
Complementing this, ams OSRAM introduced the OSLON PX family, a multipixel array in a single device. The OSLON PX24, for example, provides one row with 5–100 individually addressable

pixels, narrow LED spacing (50 μm), and multiple connection options for high system efficiency. Driver examples show flexible integration using 12-channel matrix managers.

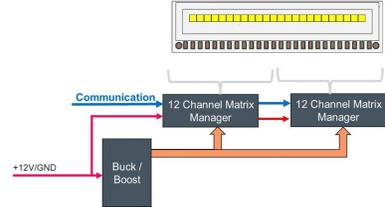
Multipixel array - Single Row - Development
Osilon PX24



OSLON PX Electrical Attachment
Offering the most flexibility in electrical connection options



PX24 Driver example



Joe also presented rectangular LEA devices for slim headlamp systems. These compact ceramic chip packages (e.g., RL 1 mm² and RM 0.5 mm²) are optimized for high flux (355–450 lm @ 1A), thermal performance, and tight tolerances for optical efficiency.

Adapted LED Chip Design for Slim Headlamp Systems

Demonstrator – Headlamp Prototype



OSRAM positioned its portfolio, ranging from EVIYOS high-resolution platforms to OSLON PX low-resolution arrays and compact rectangular chips, as offering OEMs freedom of choice in adaptive driving beam (ADB) resolution, enabling scalability across vehicle classes and headlamp designs.

OPmobility - “FMVSS ADB” Shammika Wickramasinghe

OPmobility presented the first FMVSS-approved Adaptive Driving Beam (ADB) headlamp, developed through a vertical integration approach that combined headlamp units, light driver modules, software, and algorithms. This enabled the first glare-free high beam in the U.S., with series production starting in 2024.

The system is built around a projector module stack featuring four projectors in two carriers, supporting base beam, kink (16 segments), ADB (19 segments), and signal lighting functions. Communication is enabled via CAN/CAN-FD and UART-over-CAN, with compliance to ISO 26262 (ASIL B) and cybersecurity standards.

Enabling the first glarefree high-beam in the US (SOP 2024)

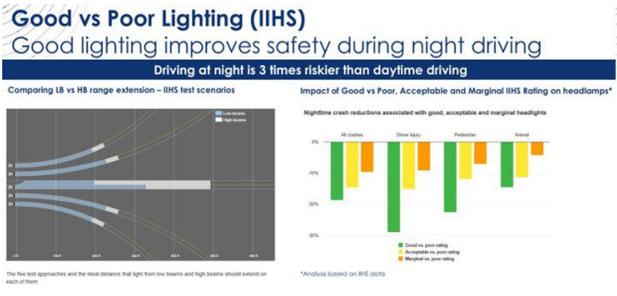
Headlamp Unit	Light Driver Modules	Software Algorithms
<ul style="list-style-type: none"> Projector with a „4 eye-look“ 2x Base Beam 16 segments Kink 19 segments ADB 	<ul style="list-style-type: none"> Up to 7 channels Can/CAN-FD UARToverCAN to LED Modules 	<ul style="list-style-type: none"> Security ISO26262 standard ASIL B safety standard Capable of Cybersecurity including AUTOSAR /OTA

Vertical development and testing of different disciplines enables the project speed

Front Lighting Module
Uniquely engineered – fully compliant by design

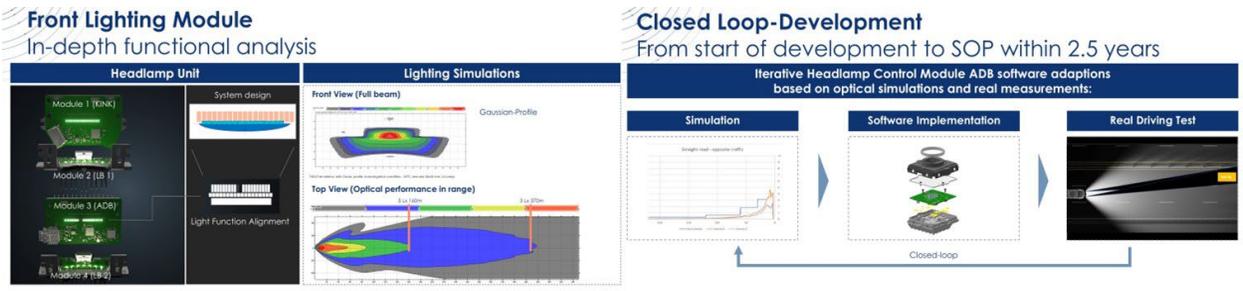
Series Head Lamp	Projector Module Stack

OPmobility demonstrated how good lighting improves safety, referencing IIHS studies showing that better-rated headlamps significantly reduce night-time accident risk. NHTSA fatality data indicates driving at night is nine times deadlier than daytime, reinforcing the role of ADB in extending visibility while preventing glare.



Testing included customer drives and fog condition trials, supported by headlamp simulations with Gaussian light distribution profiles. Modules achieved long-range performance of 160 m at 5 lx and 370 m at 3 lx, validating real-world optical effectiveness.

Development followed a closed-loop process linking simulation, software implementation, and real driving tests, reaching SOP in just 2.5 years. Iterative refinements of the ADB control module ensured compliance, robustness, and performance.



Key takeaways highlighted OPmobility’s achievement of an IIHS “Good” rating, the launch of the first U.S.-compliant ADB, global compatibility for cross-market adoption, and a scalable hardware/software architecture for future applications.

OPmobility positioned its vertical development approach and scalable ADB platform as a new benchmark for safety and innovation in front lighting, combining regulatory compliance, optical performance, and accelerated development cycles.

Lumileds - “Customized modular solutions for full Headlighting & ADB solutions, accelerating US market adoption”

Joe Cho

Lumileds presented its portfolio of LUXEON products, spanning from single and multi-chip emitters to standard and custom modules, including advanced platforms such as LUXEON FX2, Versat, Altilon, Go, LxN bulbs, NeoExact, and 3D LED PCBA/heatsinks. This supports applications from basic lighting to highly integrated Adaptive Driving Beam (ADB) systems.

LUMILEDS

Lumileds Products – From Emitters to Modules

Integration – Time to Market - Partnerships

Single Emitters	Multi-chip Emitters	Standard Modules	Custom L2/L2+
LUXEON FX2/FX2-L CW/PCA 2-pad, 3-pad	Altilon SMD, SMD-A, TopContact	LUXEON Go, Go H, Go DT, Pro	MxN – Gen2, Gen2i
Versat 3030/2020/2016 CW, PC Amber/Red/Cyan/Green, Direct Red/Amber/Cyan	Altilon SMD DT 3W, 1W	LxN, Backup/Rear Fog Module	3D LED CW/Red/PCA/Cyan*
LUXEON FX2 LUXEON Versat	LUXEON Altilon LUXEON Versat	LUXEON Go LUXEON LxN Bulbs	LUXEON NeoExact MxN LUXEON 3D LED Custom PCBA/Heatsink

LUMILEDS

What is direct imaging?

System architecture of a collimated multi-row ADB system

- Main lens system
- Holder for collimator adjustable
- Collimator optics often silicone finger design
- Array with packaged LEDs e.g. with 1.2mm spacing
- PCB
- Heatsink

System architecture direct imaging

- Main lens system
- Closely spaced LED array
- LED array light-emitting area (LEA) directly imaged to road
- No collimator used
- Closely spaced LED array required, e.g. using LUXEON NeoExact

A central theme was Direct Imaging Architecture for ADB. Unlike traditional systems with higher component counts, direct imaging reduces complexity, cuts costs, and simplifies assembly while maintaining high optical performance. Lumileds highlighted its LUXEON NeoExact MxN ADB solutions, already launched in China and Europe, with the Volvo ES90, XC90, and S90 set for production in 2025 using a 1-row, 24-pixel NeoExact design delivering ~7,000 lm.

Key Benefits of Direct Imaging Systems for ADB

#1: System Compactness
- more than 50% volume reduction vs. „finger-optics“ collimated system

#2: Reduced System Complexity
- reduced number of components

#3: Assembly Robustness
- reduced LED position tolerance sensitivity enabling passive assembly

Based on Lumileds Application Demonstrator (see earlier publications)

Lumileds LUXEON NeoExact MxN ADB Solutions – on the road

Multi-row system with FR4-inlay board: First 2 launches in China early last year, next program SOP Q1/2025

Seres AITO M5 (34-pixel 0.5mm²)

JAC Maserato S600, SOP Q1/2025 (84-pixel 0.5mm²)

PCB: 4-Layer FR4 AIN-Inlay, 76 mm x 73 mm, 7 TI Matrix Managers

BAIC Stoilato S9 (84-pixel 0.5mm²)

LED array
Lens system

Lens width: 49 mm
Tip of lens to back of board: 68mm

NeoExact arrays enable customized pixel mapping, offering flexibility in resolution and cost. For example, a 2x48 pixel module can deliver performance comparable to a 2x100 pixel module, including glare-free high beam, swiveling kink and spot, bad weather modes, IHS boosts, and support for both left- and right-hand traffic—at nearly 50% lower cost.

Lumileds LUXEON NeoExact MxN ADB Solutions – on the road

Single-row with Interposer: First 3 launches in EMEA/China very soon

New Volvo XC90 (11-row 24-pixel 1.0mm²)

New Volvo S90 (11-row 24-pixel 1.0mm²)

New Volvo E590 Q3/2025 (5-row, 24-pixel 1.0mm²)

comparable module

- 24-pixel, 1-row array NeoExact 1.0mm²
- Installed flux: 24x 300 lm ~7,000 lm
- TopContact AIN-Interposer mounted to heatsink, thick wire bonding to FR4 PCB

Lumileds is “ready for more!” – Key enablers to make your ADB project successful

Installed Industrial Footprint for full MxN solution portfolio

- High-precision LED placement and gluing of interposer to heatsink
- PCB mounting to heatsink
- Thick wire bonding of TopContact Interposers
- Automotive-qualified SMT lines
- End-of-Line testing

Full Automotive qualifications

- Market-compliant validation results available / passed
- Quick time-to-market for proliferations
- Customizations possible

Customer design-in support

- Experienced team of Application Engineers
- All disciplines: system, thermals, optics, mechanical, electrical/interfacing
- Reference designs and samples readily available
- Lab universal drivers available

Key performance highlights included low beam width from -20.2° to 13.4° at 625 cd line, high beam ADB I_{max} at 76 kcd, and compact optics with a 30 × 50 mm outer lens. These results show that high-quality beams can be achieved with smart economic LED board designs.

Smart multi-row LED array for full ADB/AFS functionality

30 mm x 50 mm outer lens

- A broad Field-of-View, decent pixelation

Nearly 50% cost reduction compared to 100px solution

- Reduced LED px count where it does NOT matter
- Smart arrangement of reference points; NO alignment for mechanical assembly required

Low Beam

- -20.2° to 13.4° width (625 cd line)

High Beam ADB

- I_{max}: 76 kcd

Excellent Beam Performance achieved with economic LED Board Design

Typical state-of-art Matrix LED array

- A broad Field-of-View, decent pixelation and contribution to both HB-ADB and LB-AFS is trademark of a state-of-the-art Matrix Beam Application. Typically, this is realized by a symmetric 100px-LED array:

Lumileds flexible Architecture allows economic design maintaining full functionality

- A smart and economic arrangement and combination of 0.5 mm² and 1.0 mm² emitters (48px) basically achieves same application performance:

- Features such as
 - glare-free HB (oncoming traffic; road and overhead sign)
 - Swiveling kink & spot
 - Bad weather light & IHS boost
 - Left- & right-hand traffic
- are fully addressed

Lumileds positioned its NeoExact MxN Direct Imaging solutions as a way to redefine ADB system design: compact, cost-effective, and industrialized. With products already on the road, Lumileds committed to providing comprehensive design-in support to accelerate adoption in mainstream U.S. vehicles.

Outlook: next level direct imaging systems, functions combined

Preoptic to separate LB and ADB/HB spread

- Single module for adaptive LB/AFS and ADB
- Higher design freedom

ADB/LB combination

- Single module
- Compact

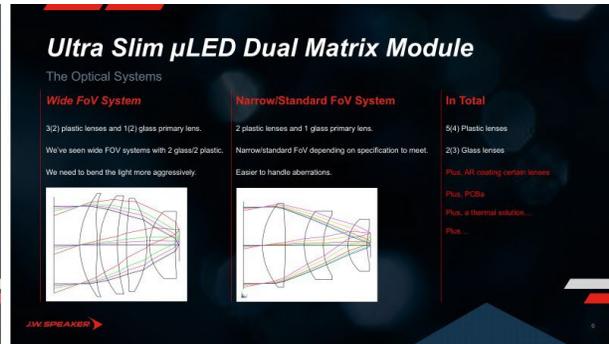
Example LB/ADB design

High Beam spread
High Beam/ADB
Low Beam

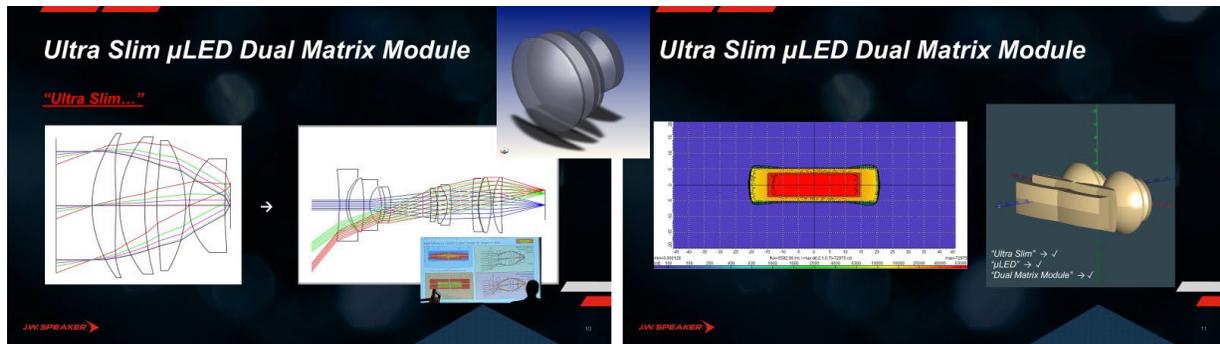
J.W. Speaker - “Ultra Slim μLED Dual Matrix Module”

Dr. David Frailey

J.W. Speaker introduced the Ultra Slim μLED Dual Matrix Module, designed to combine compact packaging, advanced optics, and regulatory compliance while maintaining strong performance at favorable cost. The concept responds to the growing trend of slim-design headlamps, achieving an aperture height of less than 20 mm.



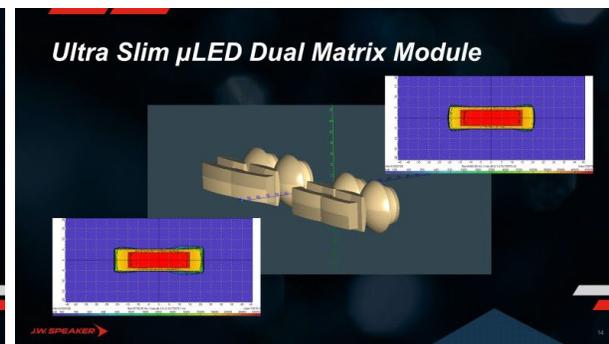
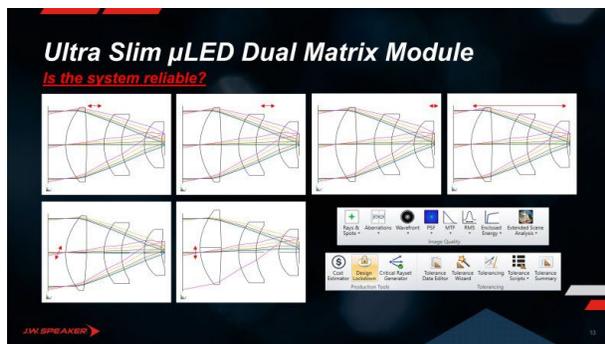
The presentation posed the challenge: how to integrate a μLED optical system into a slim form factor that meets specifications and regulations while staying cost-effective.



Two optical pathways were compared:

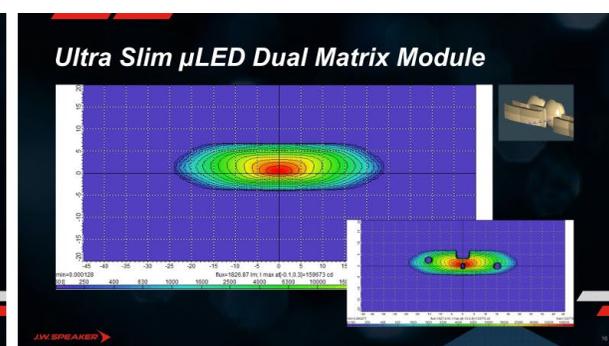
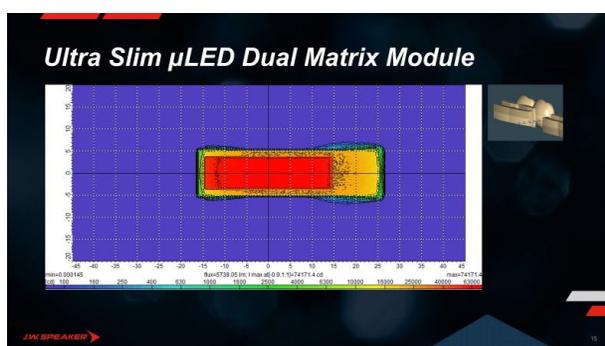
- Wide FoV system: 3 (2) plastic lenses and 1 (2) glass primary lens, bending light aggressively but introducing complexity.
- Narrow/standard FoV system: 2 plastic lenses and 1 glass primary lens, easier to manage aberrations but more constrained.

The complete optical stack could include up to 5 (4) plastic lenses and 2 (3) glass lenses, in addition to AR coatings, PCBAs, thermal solutions, and other elements, making the system very expensive.



To reduce complexity, J.W. Speaker proposed minimizing glass usage to only the primary lenses, reusing identical primaries for both systems, and maximizing the use of shared plastic lenses.

A breakthrough came with the unified system approach: using the same optical system but mapping it to different sources to produce different FoV projections. This not only simplified electrical architecture but also reduced bus communication traffic.



In summary, the Ultra Slim μLED Dual Matrix Module delivers on its three promises, ultra-slim packaging, μLED integration, and dual-matrix operation, while addressing cost and complexity through design reuse and system unification.

Valeo - "Near Field Projection: Enhanced Safety or a Gadget?"

Andrey Massey

Valeo explored the potential of Near Field Projection (NFP) as a tool for safety and communication in automotive lighting. While functions such as decorative or welcome projections are already common with limited safety benefit, extending NFP into broader communication use cases, especially for vulnerable road users (VRUs), could provide meaningful safety advantages.

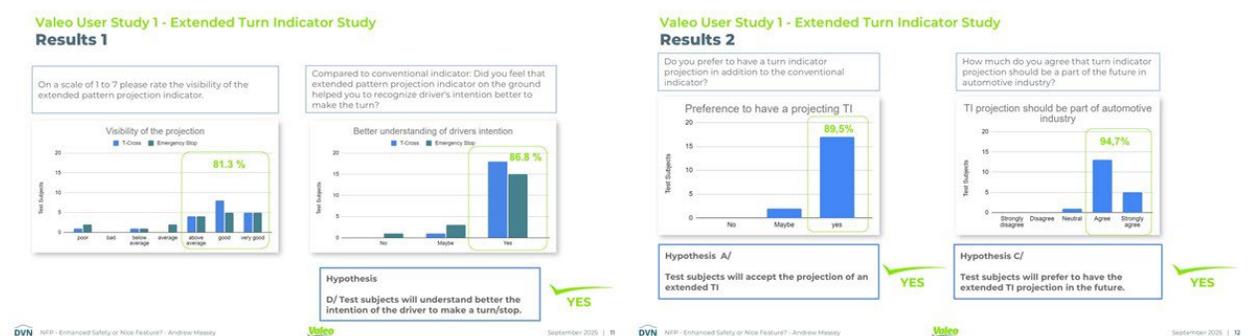
Accident statistics from NHTSA and European studies highlight the safety need: pedestrian and cyclist fatalities remain high, making clear communication between vehicles and VRUs critical. NFP could support drivers, other vehicles, and VRUs by projecting intuitive patterns for maneuvering, camera support, pedestrian warnings, or vehicle intentions.



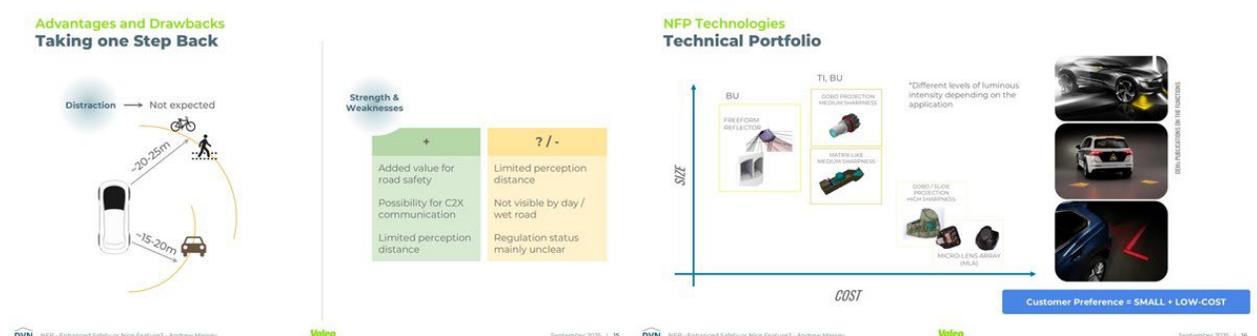
The regulatory landscape for NFP is still undefined. Currently, static projections with limited luminous intensity (<12,000 cd), same color as the main function, and simple shapes may be tolerated, but no standards exist. Valeo noted opportunities for sequential or flashing projections if harmonized regulations emerge.

Valeo's user studies provided deeper insight. Since 2019, tests have evaluated pattern size, illumination thresholds, resolution, and positioning in real traffic conditions. A 2021 study on Extended Turn Indicators (TI) projected a 1.2 m ground pattern during turns or emergency stops, tested with 19 cyclists. Results were strongly positive:

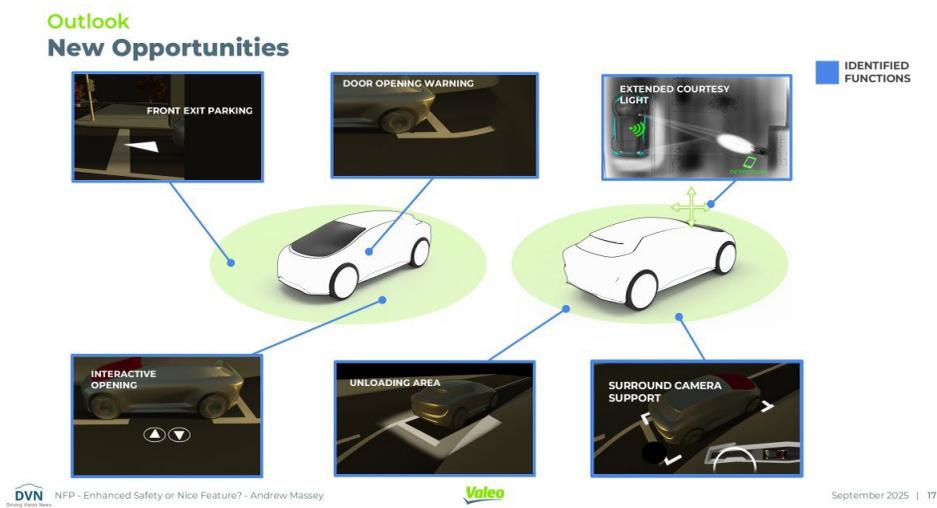
- 81% rated visibility as good,
- 87% found it improved recognition of driver intention,
- 95% believed it should be part of future automotive lighting,
- 89% preferred it in addition to conventional indicators, and
- 84% reported feeling safer in dangerous situations.



The study validated hypotheses that extended TI projections improve safety perception, visibility, and acceptance. Valeo concluded that affordable NFP solutions for functions like extended TI and reverse projection are already feasible, though further research is needed to measure direct impacts such as reduced reaction times.



In summary, Valeo positioned NFP as more than a stylistic feature: with the right regulations and validated user benefits, it can evolve into a safety-relevant technology that strengthens communication between vehicles and vulnerable road users.



SESSION 6 : CAR BODY LIGHTING

Tactotek - “Slim, Smart, and Efficient: Lighting up Emblems with IMSE®”

Dominique Heilborn

Dominique presented its Injection Molded Structural Electronics (IMSE) technology. Key benefits are that it enables slim, smart, and efficient illuminated emblems by integrating optics, electronics, and decorative surfaces into a single molded structure. The benefits are reduction of part count, weight, and system complexity.

TactoTek business approach is, not manufacture directly, but licensing their technology to ecosystem partners, providing design expertise to enabling scalable production. This approach supports wide adoption across in the automotive industry while maintaining flexibility for OEM design and branding requirements.



IMSE technology enables slim applications, allowing illuminated emblems to integrate seamlessly into vehicle exteriors without bulky housings.

Dominique also mentioned how illuminated emblems align with emerging trends in brand communication, providing recognizable identity markers that enhance styling while supporting regulatory-compliant lighting functions.



TactoTek demonstrated how IMSE technology enables illuminated emblems that are slimmer, smarter, and more efficient, offering OEMs an innovative tool for combining brand expression with functional lighting integration.

Luminit - “Visible Light Communication (VLC) and other Automotive Applications using Holographic Optically Illuminated Displays”

Jonathan Waldern

Luminit presented its patented holographic and light-shaping optical technologies with their scalability through roll-to-roll (R2R) and injection molding processes. These integrated optics offer high efficiency, low cost, and proven performance across multiple applications, with operations in the U.S. and Taiwan serving thousands of OEMs in over 60 countries

The company’s light shaping micro-optics and pseudo-random diffusers deliver Gaussian or flat-top profiles, minimal backscatter, and wavelength flexibility from 350–1200 nm, enabling advanced lighting, display, and sensing solutions.

Integrated Optical Film – Roll 2 Roll Manufacture

Holographic Mastering - Roll to Roll - Injection Molded - Volume Manufacturing

Light Shaping Diffusers

Light Shaping Micro-Optics

Luminit Holographic diffuser is the key optical component forming the digital projector HUD image, as selected by market leaders

Optical Film / Modules – Shipping Today

Creative Illumination Light Shaping Diffusers HUD Windshield Film

HUD Components & Modules Rear Combination Lights Laser Headlamps

Automotive applications include HUD windshield films, laser headlamps, rear combination lights, and creative illumination modules. Luminit’s holographic diffusers are already key components in digital projector HUDs used by market leaders, offering lightweight, thin, and conformable solutions with large eye-boxes, high efficiency, and daylight visibility.

NEW - Holographic Optics – R2R Manufacture

Volume Bragg Grating (VBG) structures recorded into photopolymer film from master, R2R printed and then laminated into windshield for auto HUD applications. Side window and sunroof also.

FEATURES	BENEFITS
Thin, light flexible film and coatings, tested to Automotive grade	Can be laminated & embedded conformally
Large size R2R fabrication capability	Low cost sheet replication & auto windshield size
High light efficiency for daytime visibility and low power for electric vehicles	Meets User & OEM acceptance criteria
Custom wavelength. Large field of view, and eye box	Broad acceptability in a variety of auto designs. Multi display configurations

Luminit R2R Holographic Copy Process

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Dynamic Brightness Adjustment

Dimmable Windshield for HUD Backdrop

Dimmable Glass for Automotive

Jonathan also covered Switchable Bragg Grating (SBG) technology, an electrically controlled holographic film that can diffract or transmit light on demand. This enables compact, tunable optical functions for applications such as rear combination lighting (RCL), digital lighting grilles, and panoramic HUDs.

Windshield HUD : Dynamic Brightness Adjustment

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Luminit Powers RCL's Today... Video Next

Laser in Automotive Lighting
Bendable Headlights with LED Organic Light-Emitting Diodes
Advanced Forward Lighting Systems

Large format Rear Combination Lighting

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Additional emerging application is Visible Light Communication (VLC or LiFi) that is projected to grow from USD 802M in 2023 to nearly USD 3B by 2029 (24.5% CAGR), can be covered by VLC, since it offers secure, high-speed data transfer in environments unsuitable for WiFi, supporting IoT, AR/VR, and autonomous vehicle integration. Luminit is working with partners to enhance VLC fixtures for industrial and mobility use cases.

Introducing - Switchable Bragg Grating (SBG) Technology

RCL or Digital Lighting Grille inc. Visible Light Communication (VLC)

Active matrix of 1D SBG pixel array and a 1D SBG bar array
Power from laser is directed to specific SBG bars, 95% extracting light toward the viewer – Using path switching and pixel-level diffraction efficiency control.

Vs. OLED Array...

- Higher Efficiency
- Higher Brightness
- Compact (Flat Panel)
- Transparent
- Holographic Virtual Image Distance (VID)
- Minimal heat dissipation
- Lower Cost

RCL - Only 1x SBG pixel 1x SBG bar for Monochrome Display

Digital Lighting Grille - Simultaneous SBG pixels and bars using microsecond switching

© 2025 Luminit Inc.

SBG for Windshield Display - Panoramic HUD

3x Tiny Projector's

1x RGB Module SBG Component

Luminit positioned its holographic diffusers, SBG technology, and VLC solutions as transformative tools for automotive lighting, HUDs, and communication, combining innovation, scalability, and cost efficiency to meet the demands of next-generation mobility.



SL America - "Kia EV9 and Cadillac Celestiq car body lighting" **Arunkumar Pesala**

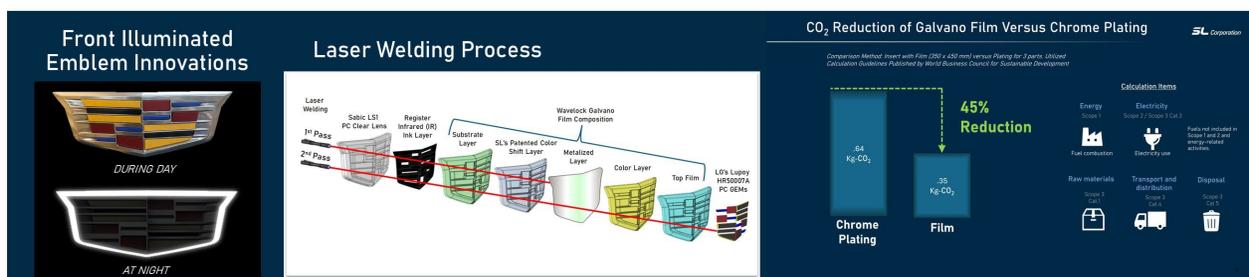
SL America showcased its "Premium Value Innovation" through the groundbreaking grille lighting of the KIA EV9, where a solid body-colored surface seamlessly transforms into a distinctive illuminated signature. This animated transition redefines vehicle presence and illustrates how lighting can shape next-generation automotive design.

The key challenge was the precision laser ablation of complex paints, including metallic, pearlescent, and highly reflective finishes like white. Achieving clarity and consistency of pattern boundaries was critical for premium appearance and scalability.



The solution combined customized multi-layer paint formulations with optimized laser processes. Proprietary laser calibration ensured durability, color consistency, and reliable high-contrast patterns across all EV9 colors. Advanced reflector design, paired with 84 LEDs per side, delivered uniform and crisp illumination.

This approach enhanced vehicle appeal by creating a unique lighting signature, while also meeting requirements for reliability and seamless OEM integration. The process supports scalable, high-volume production and positions grille lighting as both a design differentiator and a functional safety feature.

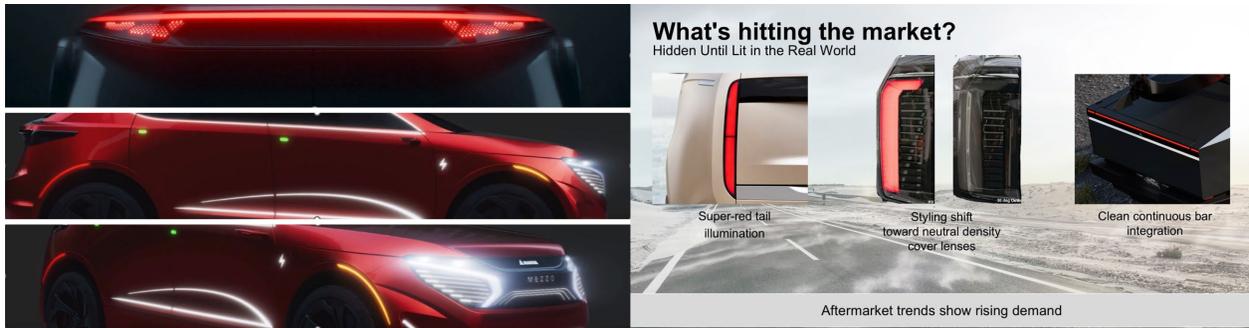


The innovation extends beyond the EV9. SL has applied the technology to rear turn signals in the KIA EV5 and demonstrated applications for illuminated front emblems, such as the Cadillac Escalade. With the introduction of laser welding through Galvano film process, SL was able to reduce 45% of CO₂ emissions when compared to chrome plating.

SL America's grille and emblem lighting technologies represent a new era of exterior styling and communication, blending premium aesthetics, safety impact, and sustainability benefits to meet the evolving demands of OEMs and consumers.

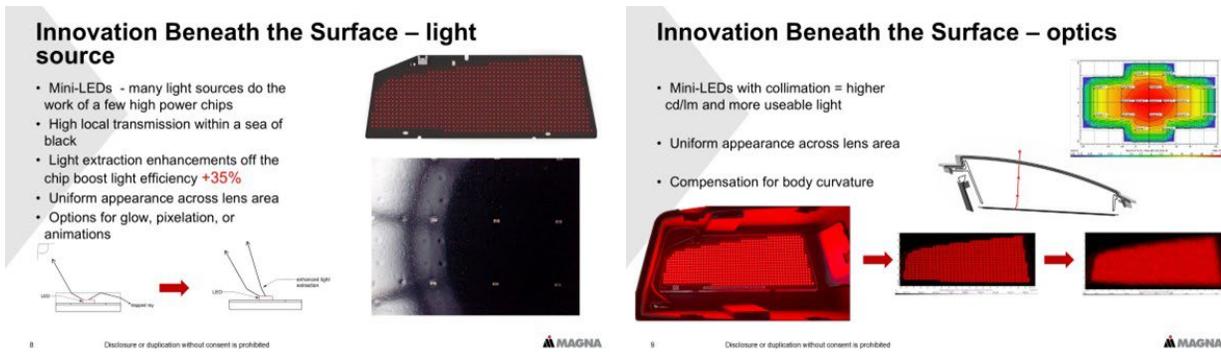
Magna - "Optically Efficient Hidden Until Lit Solution" **Edward Bailey**

Magna presented its vision for hidden-until-lit lighting, addressing how consumer demand for sleek, minimalistic, and tech-forward design is reshaping exterior vehicle styling. Traditional visible red, amber, and white lamps disrupt seamless body integration, while OEMs increasingly seek lighting solutions that blend invisibly into body panels until activated.



The design dilemma lies in material and optical challenges. Neutral density covers and heavy texturing create cloudy or grey appearances, while deep black lamps require high power and bulky heat sinks. Aftermarket modifications often fail to meet brightness regulations. Magna’s hidden-until-lit approach solves these issues by preserving styling freedom, reducing power draw, and maintaining legal color and brightness standards.

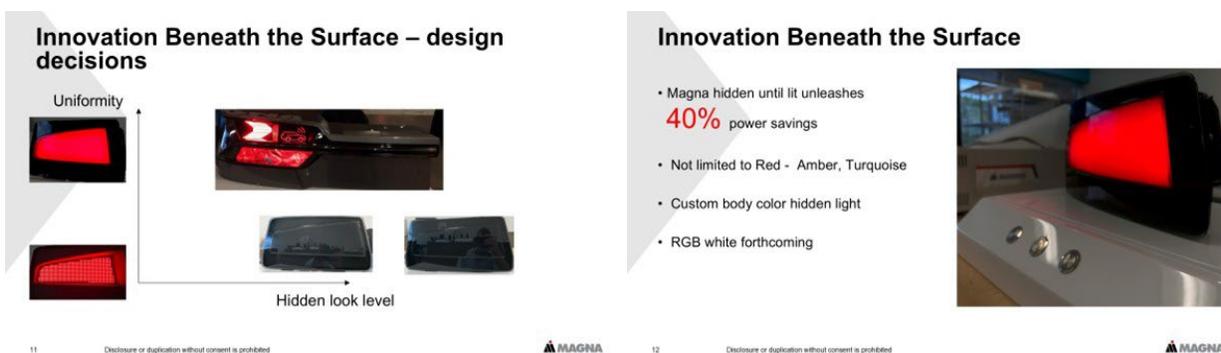
Real-world trends show growing adoption: super-red tail illumination, continuous bar integration, and neutral density lenses are entering production, while aftermarket demand continues to rise.



Magna detailed the innovations beneath the surface driving performance:

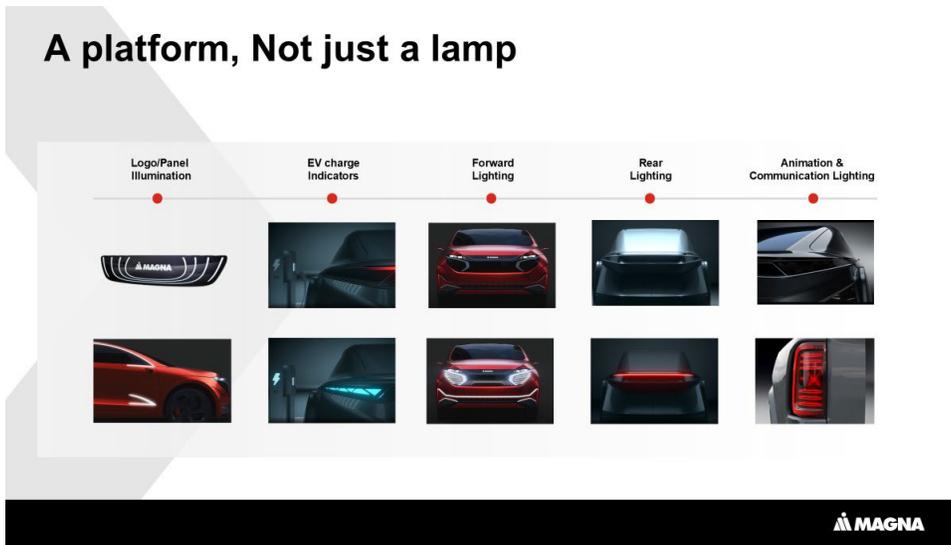
- Mini-LEDs replace brute force high-power chips, spreading workload across many sources for efficiency.
- Light extraction enhancements deliver +35% efficiency, uniform lens illumination, and options for glow, pixelation, or animations.
- Collimation optics improve candela per lumen, enhance usable light, and compensate for body curvature.
- New material strategies create deep-black unlit surfaces while preserving brightness when lit.

The result is up to 40% power savings, support for multiple colors (red, amber, turquoise, RGB white), and flexibility for custom body-colored hidden lighting. Beyond rear lamps, the platform extends to logos, charge indicators, forward lighting, and animated communication lighting.



Edward confirmed samples are already built, quote-ready for 2028+ model years, with OEM discussions underway.

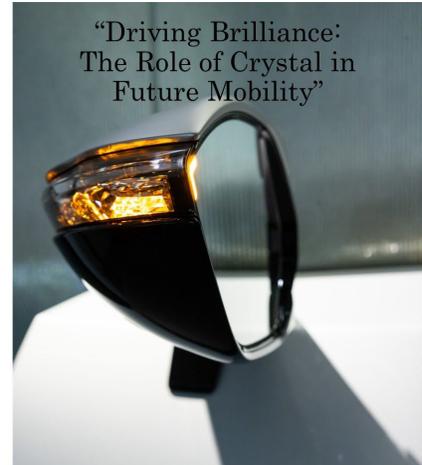
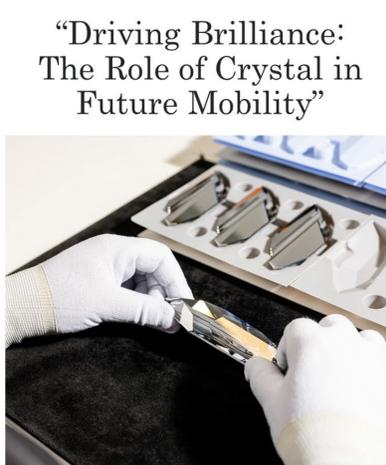
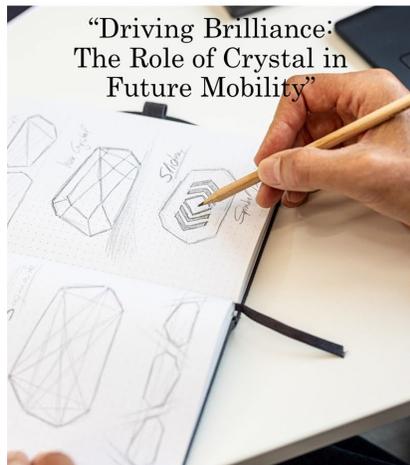
A platform, Not just a lamp



Swarovski - “Driving Brilliance: The Role of Crystal in Future Mobility”

Markus Baumann

Swarovski Mobility chose Detroit, the historic heart of the automotive industry. Swarovski Mobility entered into the U.S. market with DVN event. Markus eloquently said, “Cars of the future will be shaped by emotion, performance and technology.”



With 130 years of heritage, Swarovski is positioned as the producer of the most sustainable crystal with the highest quality, offering countless design possibilities, material advantages, and unique visual/haptic experience. Crystal guides light, controls reflection, interacts with touch and gesture.

Swarovski Mobility invests heavily in innovation and R&D, supporting the full product lifecycle from design to end-of-build (EOB) with designs that reflect OEMs' brand language. Their capabilities include Modeling & simulation to maximize value, special coatings for maximum durability & brilliance. They also remarked their differentiation with their full value stream from raw material to finished article.

“Driving Brilliance:
The Role of Crystal in
Future Mobility”



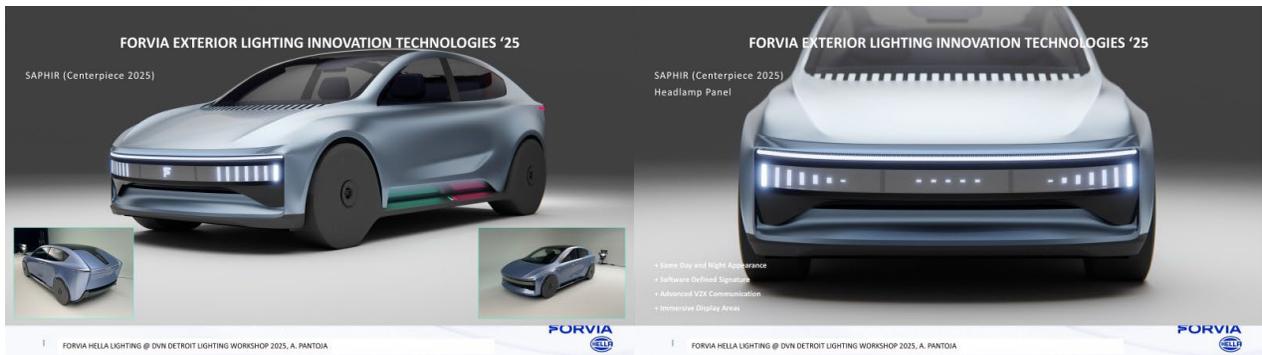
Markus stated that Crystals in Future Mobility, due to their values they bring, creates iconic light signatures and design elements and enhances ambient lighting to create calm environments. User experience is more important than ever. Crystals bring Changes in mobility, connected, autonomous, living spaces.

Markus remarked Swarovski Mobility's commitment to long-term partnerships for long-term success. Their goal is to inspire those shaping global mobility trends and unlock new dimensions of creativity, emotion, and differentiation.

In closing, the message of "Driving Brilliance" was defined as creating moments of visibility, emotion, and beauty that redefine how we experience cars, encapsulating Swarovski's mission to bring brilliance into motion.

FORVIA HELLA - "SAPHIR: Sustainable Exterior Lighting Innovations" **Antonio Pantoja**

Antonio presented its SAPHIR centerpiece concept, showcasing how advanced technologies can merge safety, communication, and immersive design into exterior lighting. The SAPHIR headlamp panel delivers a consistent day-and-night appearance, software-defined signatures, advanced V2X communication, and immersive display areas.



The headlamp system integrates multiple technologies:

- MiniLED display lighting with 148×40 pixels for position and V2X communication.
- IF|CLA modules for low and high beam.
- FlatLight "Curtain" technology for position, DRL, DI, and ADS marker lamp functions in white, cyan, and yellow.

The Essential EdgeLight concept eliminates the need for additional cover lenses by using 3D lasered optics within the part itself, supporting trifunctional performance (PO/DRL/DI).



Projection functions extend lighting into new interactive use cases. Near-field ground projectors create patterns for direction indicators, ADS marker lamps ("light fence"), cyclist safety (open-door projection), and smart trunk access, with light colors including cyan, white, yellow, and super-red.

A novel rocker panel HMI introduces immersive side displays with central MiniLED RGB panels, ambient RGB extensions, and modularity to support new communication approaches beyond B-pillar solutions.



For the rear, Forvia applied Essential EdgeLight and FlatLight µMX technologies to deliver tail, stop, and turn functions. The stop function leverages a minimum legal size illuminated area,

combined with immersive “COM Light” displays, CHMSL, lit logos, and ADS marker lamps for reversing or fog scenarios.



Other scenarios demonstrated included SmartCMX V2X displays, battery charging indicators, and projections linked to Automatic Emergency Braking. These highlight how Forvia is expanding lighting beyond illumination into communication and safety-critical functions.

Forvia positioned SAPHIR as a platform for future exterior lighting, uniting thin, efficient optics, immersive displays, projections, and V2X features into a scalable, software-defined system that enhances safety, personalization, and brand identity.

EXHIBITORS INNOVATIONS

Lumissil



Lumissil showcased their latest demos for interactive signal display (ISD) and matrix controller for Adaptive Driving Beam (ADB) headlight. For ISD, the drivers such as IS32FL3776, IS32FL3257 and IS32FL3105 that is interfaced using LumiBus(UART over CAN) were driving more than 500+LEDs in a multiplex topology. For ADB headlight, the driver IS32LT3365A/B driving Samsung Pixcell 102 LEDs to achieve a very high-resolution Adaptive zones for which automotive manufacturers are starting to adapt for their models. Additionally, Lumissil also presented on the importance of ISD safety signaling and also how it will help the rideshare community with tools and features to utilize for a perfect handshake between the driver and passenger before the start of every ride.

ASYST Technologies



ASYST Technologies showcased its leading innovative automotive lighting technologies and products at Detroit DVN Workshop. ASYST Technologies made a strong impression with a trio of standout innovations:

- **Tolerance Compensators:** Attendees were especially enthusiastic about ASYST’s precision-engineered compensators, which address mounting variability and ensure consistent alignment across headlamp assemblies. Their adaptability supports both styling freedom and regulatory compliance.
- **Thermal Management Solutions:** ASYST highlighted its advanced thermal control Plastic Heat Sink module designed to optimize LED performance and longevity. These systems help maintain stable output and prevent overheating, crucial for high-power lighting modules.
- **Headlamp Aiming Adjusters:** The company’s standard adjusters were praised for their reliability and ease of integration, offering OEMs a robust solution for precise beam alignment in both manual and automated setups.

Overall, the event was just as successful as others for ASYST and many promising connections with OEMs, Tier 1s and suppliers were made.

Luminit



Luminit presented its latest optical innovations for automotive lighting and display technology at DVN Detroit. At our booth, visitors experienced Light Shaping Diffusers® (LSD®) for ultra-thin taillight designs, enhanced brightness, and energy-efficient performance, addressing the growing demand for sleek styling and sustainable solutions.

We also showcased our holographic optical elements (HOEs) and advanced AR & In-Plane HUD technologies, which deliver crystal-clear data overlays, reduced glare, and immersive driver experiences. Luminit's scalable roll-to-roll holographic film manufacturing was highlighted as a key enabler for panoramic, dimmable windshield displays that replace cluttered dashboards with safer, eyes-forward information.

Together, these demonstrations underscored Luminit's role as a trusted partner to automakers and Tier-1s, shaping the next generation of lighting and display technologies for the future of mobility.

OLEDWORKS



OLEDWorks attended the DVN US Workshop in Detroit, displaying its robust and automotive qualified [Atala](#) organic light emitting diode (OLED) technology.

Attendees were able to view both flexible and rigid high-brightness Atala panels at the OLEDWorks booth. Flexible panels can bend and wrap around a vehicle, allowing light to follow curves for greater visibility and design freedom. This functionality increases viewing angles, enhances communication capabilities, and improves safety for any vehicle.

To demonstrate the wide range of applications for Atala products, OLEDWorks also showcased OLED lighting panels in red, white, and amber. With red lighting on the road and amber and white lighting in development, future Atala products can offer beautiful and dynamic lighting solutions for taillights, turn signals, brake lights, interior lighting, daytime running lights, and lit badging.

Cutting-edge Atala panels at DVN Detroit expressed form, function, and safety in an elegant package. They are the thinnest, brightest, and longest-lifetime OLED lights on the road—customizable for the segmentation and luminance that each location and function of the vehicle requires.

Toshiba



Toshiba Lighting & Technology Corporation proposes socket-type LED light sources that retain the convenience of traditional incandescent bulbs while supporting a wide range of design applications. These products simplify lamp design and enable a significant reduction in the time required for evaluation and mass production.

Installation is as straightforward as with incandescent bulbs, and in the event of a failure, only the light source component needs to be replaced.

The lineup includes UNECE standard products, and the more powerful 6 series is compatible with long lamps and wide-area lighting fixtures. Additionally, customized solutions for individual customers are available. For example, it is possible to combine light sources that were previously needed for different 3 functions, such as stop turn signals and tail lamp, into a single light source, reducing the number of parts and lowering costs for customers.

Brightek

Brightek presented their innovative smart lighting solutions at the DVN Lighting Detroit Workshop: the ETR Smart Transceiver for centralized control systems and the LIN-Lite module, a compact single-LED RGB solution with built-in LIN control.

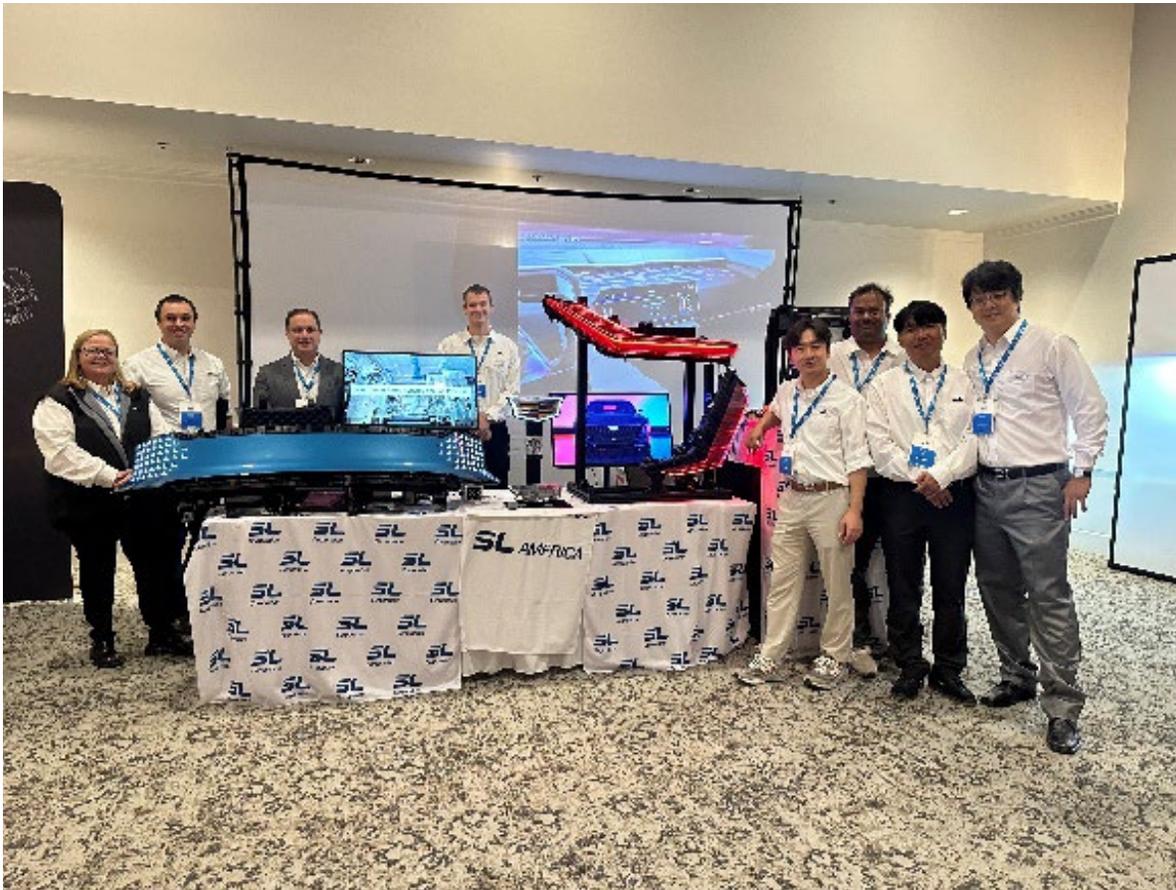
The ETR is a smart transceiver that bridges SPI, I²C, and CAN FD, supporting up to 31 slaves per SPI port and reliable CAN FD transmission over 10 meters. It features built-in lookup tables for temperature compensation and broadcast functionality for streamlined communication.

Debuting at the DVN Lighting Detroit Workshop, the LIN-Lite module combines ICLED, LIN transceiver, and a microcontroller into a single ultra-compact footprint. Designed for seamless integration into LIN-based systems, it features auto-addressing, single-wire LIN protocol, direct vehicle power connection, and improved thermal management.

By uniting communication, control, and diagnostics in compact, efficient designs, Brightek's ETR and LIN-Lite solutions represent the next step toward intelligent automotive lighting. These innovations help automakers reduce complexity, boost reliability, and accelerate the transition to smarter, centralized lighting systems.



SL Corporation



SL Corporation, a global Tier 1 automotive lighting leader, showcased its trademarked Premium Value Innovation, which serves as the company's guiding principle to deliver value-added innovation to customers and forms part of SL's corporate DNA, at the DVN Detroit Lighting Workshop. This mindset blends Style and Safety in next-generation car lighting. Key innovations include simplified molding with robust PC blade integration, industry-first hidden-until-lit body color lighting through the Kia EV9's laser-ablated grille, and pioneering laser welding of metallic films for seamless, durable components.

These technologies appear in production vehicles such as:

Kia EV9's laser-ablated hidden grille illumination with integrated body color lighting

Cadillac Celestiq's unified DRL with integrated DMD technology

Cadillac Escalade's lit Galvano emblem with laser-welded metallic films ensuring consistent illumination

At DVN, SL deepened collaborations with top OEMs across studios and leadership teams. Arunkumar Pesala, Advanced R&D Systems Program Engineer, led the Car Body Lighting seminar, presenting these advancements as benchmarks for blending aesthetics and safety in future mobility.

Swarovski Mobility



Swarovski Mobility took part in the DVN Detroit Lighting Workshop on September 9–10, the company's first participation in an industry event in the United States. The debut was an important step to introduce Swarovski Mobility to the U.S. market, engage with leading players, and demonstrate how its crystal-integrated lighting solutions can contribute to the future of mobility. The event provided an ideal platform to highlight the company's technological capabilities and strengthen awareness in this strategically significant region.

Head of Sales & Quality Management Markus Baumann delivered a keynote speech during the conference, presenting Swarovski Mobility's vision and outlining the opportunities offered by advanced lighting and crystal integration. On display at the booth were two key demonstrators: the Wing Mirror and the FrontIQ Headlight. Both attracted strong attention from OEMs, Tier-1 suppliers, and design experts, who showed particular interest in the way Swarovski technology combines aesthetics with function to create distinctive new possibilities in lighting and safety.

The participation in the Detroit event proved highly successful, resulting in several important new contacts and constructive feedback from industry stakeholders. Attendees expressed strong interest in evaluating the demonstrators for upcoming projects, while discussions also offered valuable insights into U.S. market expectations and regulatory requirements. Overall, the event marked a significant milestone for Swarovski Mobility, opening the door for further engagement and business development in North America.

Valeo

Valeo presented its Lighting System portfolio, showcasing interior & exterior lighting as well as controller range. From dynamic RGB interior lighting, illuminated logos, power controllers, headlamp modules and homogenous signaling technologies, Valeo Light Division drivers are safety, style and performance.

In addition, our technical experts provided the following lectures:

- Kumail Syed, : “Interior Lighting in Software-Defined Vehicles”
- Andrew Massey: “Near Field Projection: Enhanced Safety or a Nice Feature”
- Mark Verplank, “SAE J3308™ – Driver Assistance Projections (DAP) & Signaling Road Projections (SRP) Overview”



The DVN event was once again a great opportunity to connect with our OEM customers, DVN colleagues and partners.

We are looking forward to contributing to the next editions.

Filtration Group – Oxyphen & FlowDry

Filtration Group, through its Oxyphen and FlowDry divisions, showcased innovative solutions for lighting protection and moisture management at DVN Detroit 2025. Our portfolio attracted strong interest from companies seeking reliable, cost-effective, and sustainable technologies.

Featured Solutions:

OptiClear® Passive Condensation Management Device

We presented generation 1 and generation 2 of the OptiClear device. The device controls humidity within headlights and taillights without any electrical power. It is fully regenerative and lasts for the lifetime of the light module.

Oxyphen Track-Etched PFAS-Free Membranes

Precision venting with proven automotive protection. Enables OEMs to meet performance targets while supporting compliance with PFAS regulations.

Commitment

Filtration Group helps customers meet next-generation lighting challenges by controlling humidity, simplifying venting, and providing solutions that align with sustainability and regulatory demands.



Ansys



The Optics and Autonomy teams at Ansys were at DVN Detroit to present their end-to-end solution for the virtual validation of automotive lighting & vision systems. At their booth, they mostly highlighted Ansys Lumerical, Zemax OpticStudio, Speos and AVxcelerate, but their product portfolio goes well beyond optical simulation. Ansys offers a broad range of simulation solutions specifically tailored for the automotive industry, helping manufacturers and suppliers design safer, more efficient, and innovative systems.

In addition to their booth, Ansys also presented on 'Virtual Prototypes for Appearance Validation of Automotive Lighting' where they talked about the use of simulation renderings as a replacement of physical mock-up to speed up the development time and reduce cost.

Ams Osram

ams OSRAM presented a new **XLS (eXchangeable LED Light Source)**. **LW7** is an ECE R128 standardized platform for automotive signal lighting. This standardization allows for high-volume production and economical pricing. Its "**off-the-shelf**" nature ensures long-term availability and a robust supply chain. The module is designed to be durable for long and reliable operation.

Applications and Functionality

The XLS is designed for innovative **Daytime Running Light (DRL)**. Its compact size and compatibility with light guides provide significant design flexibility, enabling stylish, uniform lighting appearances.

A key feature is the **dual-color module**, which can provide **both DRL and turn indicator** functions from a single unit. The white light for the DRL has a luminous flux of **600 lm**, while the amber light for the turn signal is **450 lm**. LW7 with a luminous flux of **750 lm** can illuminate a one-meter light guide with homogenous light distribution.



Marelli

During the two inspiring days at the DVN Lighting Workshop in Livonia, Michigan, Marelli showcased some of their newest automotive lighting products:

- Opel Grandland Headlamp, the 2025 DVN Munich winner for Best Front Light Design, featuring intelligent, compact and energy efficient h-Digi® microLED modules, ADB, illuminated 3D front panel & 3D lit logo;
- Volkswagen Tayron Rearlamp, featuring homogeneous folia LED technology with animations & illuminated logo;
- Audi Q6 Digital OLED 2.0 Taillamp, our 2025 PACE award winner, featuring 60 individually controlled OLED segments, distinct change in light appearance, thus increasing safety, customizable patterns and a very thin light surface;
- Lighting Electronic ECUs (Electronic Control Units).

A key highlight was the contribution of Colby Childress, Marelli Optical Manager, during the Lighting and Safety session with his lecture on “Infrared Support for Future AEB”. He shared insights on the integration of advanced lighting systems with Autonomous Emergency Braking (AEB) technology and explained how the enhancement of vehicle safety and performance will be mandatory in the US across all vehicles in the future. To address AEB needs, Marelli proposes additional, dynamic lighting systems in the visible and near infrared ranges without compromising the benefits of emerging technologies such as US-ADB.



Idemitsu Chemicals U.S.A. Corporation

This was Idemitsu's first time exhibiting at the DVN show here in Detroit. It was a wonderful experience to really engage with those in the automotive lighting field and present our materials. Idemitsu displayed our new grade LC150A for long pipe guide DRL lighting. This new improved grade shows higher durability in humid and heat environments allowing it to keep its transmittance properties crisp and clear, than our current material. Regarding DRLs we also had on display our LC1700 series used for thick LED lenses and DRL light guides. Due to its strong molding capabilities its less likely to yellow and will keep a crisp and clear tone, during longer molding cycle times. In addition to our DRL materials we also introduced our interior diffusive polycarbonate grades, LD1700V series, that work either as a diffusive cover for an interior light pipe or for LED arrays so you cannot see the LED points behind the diffusive cover.



Diode Dynamics



Diode Dynamics was pleased to exhibit for the first time in Detroit, displaying a variety of lighting solutions provided to its specialty OEM clients. After speaking to clients, suppliers, and industry friends at the workshop, it is clear that low-volume support is a growing need in the industry, whether intended for low-volume OEM production, special trims, service parts, dealer-installed options, accessory options, and more.

With Diode's ability to design, validate, manufacture, and distribute lamps from a single vertically-integrated facility, it is well-positioned to meet this growing demand. Its team of 80, located just outside St. Louis, Missouri, maintains full engineering capabilities, pre-compliance testing equipment including a goniometer, along with production capabilities including circuit board assembly, injection molding, and lamp assembly. Finally, it warehouses and distributes hundreds of parcels daily from its warehouse, supporting logistics needs. From sidemarker lamps, front decorative lamps, up to full headlamp assemblies, Diode Dynamics is well-suited to be your low-volume partner.

Highlights from the conference included speakers on a wide range of topics, learning about new and innovative technologies and solutions from Tier 2 and Tier 3 vendors, and re-connecting with many industry partners. The team at Diode Dynamics looks forward to seeing everyone again next year!

MPLD



MPLD is a leading and independent manufacturer of vibration fixtures and validation jigs for quality tests.

Thanks to the know-how we gained in more than 20 years of experience, the continues investments in technology and human resources, we offer high quality products and services with certified processes according to ISO9001.

Most of our manufacturing takes place internally in our departments of R&D, production, assembly, dimensional control and dynamic validation.

We like to work with our customers as a consultant in the whole validation process to define together the jigs necessary to validate the product in order to optimize all the cost parameters.

Each fixture is realized in order to maximize performance, ensure repeatability, minimize time setup and facilitate the work of the validation engineers.

J.W. Speakers



J.W. Speaker Corporation's participation in the DVN Workshop in Detroit, MI on September 9th and 10th continues to provide valuable networking opportunities. It presents a valuable opportunity to showcase and exhibit our capabilities as well as continue to stay up to speed on market trends and global regulatory direction.

As we focus on high end technology driven solutions for vehicle lighting packages meeting global industry regulations in the low to mid volume segments, this conference continues to provide exposure and credibility to our capabilities. We hope it demonstrates our ability to be a valuable partner with design and production completely vertically integrated in the USA.

On exhibit were lamps designed for high-end sports cars, Class 8 Trucks, Aftermarket Accessories such as Snowplows, and Motorcycles. Technologies were exhibited such as our Lens Heating Technology, Our μ PLS 16k pixel control and optical systems including our lecture on the Dual Ultra Slim Matrix Optical Module, as well as our 90mm 5-function headlamp which is considered the smallest package solution available offering all five forward lighting functions for vehicles narrower than 2032mm. Our capabilities on optics design and tight packaging, along with our unique tooling strategies and capabilities differentiate us in the lower volume segments of the automotive market.

J.W. Speaker has recently obtained our IATF 16949 and ISO 14001 certifications showing the desire to be considered more strongly in the automotive market than previously pursued. We hope our continued engagement will position us well for the right size opportunities with our domestic partners looking for a local development team to help advance the performance and capabilities of their exterior lighting packages.

Covestro

For more than 50 years, Covestro has been a valued supplier and development partner for the automotive industry. Focusing on our customers' continuous requests to implement innovative, high performance, cost saving and sustainable solutions, we have jointly created "The Material Effect": combining our material science with processing expertise and application development, providing solutions that can be used throughout all vehicle design.

We developed and showcased fully functional demonstrators and production parts that allow our customers to experience our products. With the right selection of materials, we turn designers' dreams into reality for interior and forward lighting technologies:

- "Black-until-red". Makrolon® AG2677 for exterior lenses, the different light transmission levels offer 2x-6x more light than other "black" lenses in the market, the opportunity to reduce heatsink size and use less LED power in the application
- Light Bar. Makrolon® LED for homogeneous long, thin, curved optical lenses, minimizing fill pressure, warpage, packaging, weight, complexity and cost of light bar assemblies for mass production. Additional decorative features on the lens, bezel and backside possible
- Several heatsink applications with Makrolon® TC for high performance, lightweight, cost-saving and dimensionally stable heat management parts
- Next generation of our Mono-material headlamp with novel laser welded Makrolon® TC housing offering lightweight (~40% less), cost-savings, easier manufacturing, recyclability and up to 58% CO2-eq reduction
- Film-Insert-Molding, In-Mold-Electronics, Printed Electronics, Neutral Density, Diffusive Polycarbonate grades and various other decorative applications



Nissha

At our booth at DVN Detroit, NISSHA showcased its interior and exterior lighting capabilities. For interiors, we presented Mutech, combining Mute with technology. Specifically, we exhibited HiddenIcon, HiddenGraphic, and HiddenDisplay.

For exteriors, We focused on the exterior functional panel and they consists of three products. The first is Wire Heater, which generates heat by embedding wires within decorative film, providing snow melting functionality and radar transparency. The second is Lumistyle, which achieves light transmission and fine line patterns through printing technology. The third is PureCoat, which uses PUR resin and in-mold coating technology to achieve high hard-coat properties and a transparent, deep design. Since today's conference focuses specifically on lighting, we will concentrate our explanation on Lumistyle.

Lumistyle is a brand that combines luminous with design. Its defining feature is enabling designs impossible with conventional inner lenses. We will explain the achievable designs in detail later. Furthermore, by utilizing our IMD technology, we can shorten tact time and provide cost-competitive products.

We've prepared samples featuring adjustments to transmittance, designs with Hidden effects, and samples combining these with Body colors. If you haven't seen them yet, please come take a look. We're also developing versions with Diffusion functionality and plan to unveil them at the next DVN Shanghai.

We have CMF specialists globally who can support you from the early development stages to realize your desired decorative finishes and lighting designs. We own this prototype, so please feel free to utilize it.



Magna

Magna is redefining the future of automotive lighting with advanced technologies that seamlessly integrate safety, performance, and design.

At the DVN event in Detroit, Magna demonstrated its Invision™ Adaptive Driving Beam (ADB) system through a live vehicle showcase. Fully compliant with FMVSS regulations, this next-generation lighting technology dynamically adapts light distribution benchmark in intelligent road illumination. At its booth, Magna also highlighted High Definition, Bi-LED, and Thermal Spotlighting projectors, further demonstrating the breadth of its lighting innovations.

Additionally, Magna presented its Optically Efficient Hidden Unit Lit Technology, a breakthrough that unites sleek aesthetics with uncompromising performance. Hidden in plain sight until activated, it delivers powerful, precisely directed light while maintaining a clean, seamless surface design.

Together, these innovations exemplify how Magna continues to merge cutting-edge engineering with modern design, enabling OEMs to meet evolving industry demands and driver expectations. With smart, sustainable, and stylish lighting solutions, Magna is illuminating the path forward in mobility.



NETWORKING









LIST OF MAIN DVN MONTHLY REPORTS

Main reports launched in 2008-2020

Koito company profile
China lighting market
The Wonderful World of Passenger Car lighting
Tier 2 and 3 contribution on automotive lighting
ZKW company profile
Simulations in automotive lighting
Mercedes-Benz profile
LED technologies in automotive lighting
LEDs Thermo-Electrics
Interior Lighting
BMW and lighting
Lighting and ADAS
Materials in lighting
Laser Head lighting
Automotive lighting Regulations worldwide
Israeli Startups
Jaguar Land Rover and lighting
Engineering companies involved in lighting
Japanese lighting market
Status of w/w Regulations
Korea Lighting Market
SL Corp profile
ADB/Matrix Beam
India Car Industry and Lighting Market
Vision of lighting 2025-2030
Automotive lighting Regulations worldwide
Vehicle Lighting in USA
New ADB technologies
Interior Lighting
Camera technologies
Varroc profile
Volkswagen profile
US automotive lighting industry
Materials in Vehicle Lighting
The Future of Exterior Lighting
IAA Frankfurt Autoshow
DVN Munich WS
GENEVA Autoshow
US Lighting
Marelli AL Profile
50 years Light Styling
ADAS and Lighting

Main reports launched in 2021

Evolution of LEDs
New Models July-October
2020 Audi Lighting & ADAS
Lighting in development countries
ADB Update
DVN Shanghai WS
Innovations in Rear Lighting
Global Landscape of Automotive LED Suppliers

Reports launched in 2022

Technologies presented in CES 2022
Laser light automotive lighting
ISAL report
DVN US workshop
Worldwide Demographic Development
Models launched May to August
DVN Shanghai report
VISION congress
Paris Autoshow + last Vehicle models
L.A. Autoshow

Reports launched in 2023

CES Report
TU Darmstadt Lighting Institute
DVN Paris Workshop
Universities and Lighting
MLA Technology
Models launched in H1-2023
DVN Tokyo Workshop ISAL Report
DVN US Workshop
Osram Company Profile
DVN Shanghai Workshop

Reports launched in 2024

CES
New cars of the semester
DVN Munich Workshop
OLED Technology
Beijing Autoshow
Display Week
2024 DVN Detroit Workshop
ALE, June 2024
Indian vehicle lighting market
DVN Pune Workshop summary
New cars 2024
Nichia company profile
Test houses
Shanghai DVN event summary

Reports launched in 2025

CES and Bharat Mobility Global Expo
DVN Munich event summary
Dekra testhouse
SPE Plastics in Electric
& Autonomous Vehicles (EAV)
Auto Show Shanghai
IAA
DVN Detroit Report

DVN ecosystem and scientific community

DVN is a reference in the world of Lighting, Interior comfort and Lidar

Car Makers

Audi
Avatr Technology
Bentley
BMW
Ferrari
Ford
Ford Otosan
General Motors
Genesis
Hero MotoCorp
Honda
Hyundai
Jaguar-Land Rover
Kia
Lotus cars
Lucid Motors
Mazda
Mercedes-Benz
Mitsubishi Motors
Nio
Nissan
Renault
Rivian
Seat
Stellantis
Subaru
Toyota
TVS
SAIC Volkswagen
Volvo Cars
Zoox

System Suppliers and Tier 1s

Adient
Anruì
Appotronics
Aspöck Systems
Braslux
Cepton
Ceres Holographics
Chongqing Rebo
Continental
Creat
Diode Dynamics
Elba
F2J Industry
Feka
Fiem Industry
Flex-N-gate
FORVIA designLED
FORVIA HELLA
GHSP
Grupo Antolin
Hascovision
Hitachi
Ichikoh
J.W. Speaker
Keboda
Koito
Lightworks
Lumax
Luxit
Maier

Magna
Marelli
Marquardt
Mind
Mobileye
Mobis
Muth Mirror Systems
Nordic Lights
Odelo Farba
OPmobility
Panasonic
Polycontact
Prettl group
Rehau
SL Corporation
SMR Automotive
Stanley
The Lighting Consultants
Toyota Boshoku
Uno Minda
Valeo
Varroc
Weidplas CH
Xingyu
Zanini
ZKW
Zodiac

Light Source Suppliers

ams OSRAM
APT Electronics
Brightek
Dominant Opto Tech.
Everlight Electr.
HC Semitek
Kyocera SLD Laser
LG Innotek
Liteon Technology
Lumileds
Nichia
OLEDWorks
Refond
Samsung LED
Seoul Semiconductor

Tier 2s and service providers

A2Mac1
Ascorium
AML Systems
Ansys
ASAP
ASYST Technologies
Auer Lighting
BASF
Bluebinaries
Brightview Technologies
Capgemini
CLM Search
Coindu
Covestro
Dajac
DBM Reflex
Delo

Die haptiker GmbH
Docter Optics
Dow
Edag
Elmos
Endego
Ennostar
Euro Moulders
EV Group
Flow Dry Technology
Focuslight
Fusaware
Grewus
HJ Optics
Huawei
Idemitsu
Infineon
Inova Semiconductors
Instrument Systems
Integrity
Joysonquin
Leonhard Kurz
L.E.S.S.
LMT
Luminus
Mektec
Microvision
Maxell Frontier
MD Group
Melexis
Microchip
Microrelleus
Mitsui Chemicals
Mocom
Nalux
NBHX Trim
Oerlikon
ON Semiconductor
Pininfarina
Polyrise
Preh
Ray Group
S&P Global Mobility
Sabic
Schott
Seaborough
Seoyoneh-Ewha
Shihu
SP3
Sunny Automotive Optech
Suzhou Senbo
Synopsys
TechnoTeam
Toshiba lighting
TQ Technology
Uni Tooling
Ventura
W Research Company LLC
W.L. Gore & Associates
WLOPT
X2F
Xunchi

Universities, NGO and labs

Alliance for Automotive Innovation
ARAI
Automotive Research Association of India
BMDV
Bundesministerium für Digitales und Verkehr
CATARC
China Automotive Technology and Research Center
CEA Leti
Darmstadt university
DEKRA
Department for transport, UK
DTI
Danish Technological Institute
DVR
Deutscher Verkehrssicherheitsrat - German Road Safety Council
Estaca
École supérieure des techniques aéronautiques et de construction automobile
Fraunhofer (FEP, IAP, ILT, IMS)
Fudan university
GTB
Hannover Leibniz
Hochschule Aalen
Hochschule Magdeburg-Stendal
Icahn School of Medicine at Mount Sinai
Light and Health Research Center
ICAT
International Centre for Automotive Technology
Idiada
Institut d'Optique
JASIC
Japan Automobile Standards Internationalization Center
KBA
(Kraftfahrt-Bundesamt)
KATRI
Korea Apparel Testing & Research Institute
KIT
Karlsruhe Institute of Technology
Kotsa
Korea Transportation Safety Authority
LCOE
Laboratorio Central Oficial de Electrotecnia
L-LAB
MLIT
Ministry of Land, Infrastructure, Transport and Tourism
NHTSA
National Highway Traffic Safety Administration
OICA
International Organization of Motor Vehicle Manufacturers
Pacific Northwest National Laboratory
Phabulous
RDW
RISE Research Institutes of Sweden
Sapphire STS
SMMT
Society of Motor Manufacturers And Traders
SMVIC
Shanghai Motor Vehicle Inspection Certification
TNO
Traficom
Transport Canada
UMTRI
Université Gustave Eiffel
UTAC
VDA
Verband der Automobilindustrie
VEDECOM
Vrije Universiteit Brussel
YoungNam University

