# LACES: Los Angeles Auto Show 2018
# •and•
# Consumer Electronics Show 2019

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## About the author

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## Executive Summary

The Los Angeles auto show is the North American hot spot for newly-released and forthcoming production cars as well as production-plausible concepts; CES in Las Vegas caters for the farther-out ideas, the reimagining of traffic and transport up and down the scale from micro to macro. Taken together, the two shows provide an almost seamless, comprehensive look at the current, foreseeable, and imaginable state of the art in vision systems for drivers—human and vehicular alike. Key takeaways:

• Although terms like "personal transport" are burgeoning, with intent to include modes and methods not presently common, clearly automotive vehicles recogniseable as such will carry on dominating for quite awhile.

• The question of whether tomorrow's cars will need or have lights appears to have been answered: Yes.

• We have passed the tipping point; LEDs are the standard technology for making light on cars.

• Machine-vision and human-vision systems are merging on a physical, practical level; there's keen interest and a great deal of innovation going into integration of sensors and cameras in front and rear lights.

• In today's lights, design and style are being leveraged like never before for brand identity and cohesion and to advertise the whole vehicle's level of technology.

• A most unlikely styling element from yesterday appears to be gathering momentum towards a comeback: the tailfin!

Even at the giant Los Angeles show, concept cars as we have known them in the past are on the decline. There weren't a lot of concept, prototype, or dream cars—probably due in part to today's short product development cycles. Also the galloping pace of technological advancement is at work here; even the pre-production prototypes and newly-unveiled production cars are essentially dream cars in and of themselves, bristling with levels of technology and capability well outside yesterday's bounds of practicality. And there was absolutely no shortage of interesting lighting; the general trend is clearly toward higher lighting content on most vehicles offered in the world's second-largest vehicle market.

One crucial piece of the context that separates this show from others round the world is that the US is one of the two countries on the North American regulatory island: the United States has its own lighting regulations, significantly different to the UN (or UN-approximate) regulations recognised by most of the rest of the world. So most vehicles on offer in America—and therefore most vehicles on display at the show—have different lighting system specifications and particulars than their equivalents elsewhere in the world. Red rear turn signals are (still) allowed in America, for example—though this year there were interesting signs of how makers are adapting to a planned NCAP preference for the yellow ones the rest of the world requires—and front and rear side marker lights and reflectors are required, but side turn signal repeaters and rear fog lamps aren't. DRLs also are not required in the US, but most vehicles have them now, whether motivated by safety or styling drives. ADB is (still) not yet legal in America, so models that come equipped in Europe are stripped of that feature for the American market. And there are minimum-lit-area (EPLLA) requirements for stop and rear turn signal lights in America, though there seems to be something of an unspoken contest running to see who can flout that rule the hardest.

Overall, last year's news is also this year's news: increasing lighting and ADAS content on the front, sides, and rear of vehicles, and more fervent striving towards autonomous driving. But this is not a one-way trend; there are still newly-designed vehicles presenting with H4 headlamps—state of the art circa 1969. Nevertheless, the whole industry worldwide is striving at an unprecedented rate to add glitz and fascination to what used to be purely functional, minimally-styled equipment. It is surely safe to say the old philosophy of vehicle lights as commodity items is now almost a thing of the past. Another trend on the obvious strong increase is the use of lighting for brand and model-range identity advertisement. Meanwhile, technical and technological advances in the intelligence and inbuilt capabilities of the traffic system as a whole are rapidly moving from science fiction to science fact.

# Introduction

This, DVN's 134th report, is a close and focused look at the new and notable lights and seeing technology, broadly inclusive, on the vehicles at the 2018 Los Angeles auto show and the 2019 Consumer Electronics Show at Las Vegas. That is the fine-pointed focus of this report, to the almost total exclusion of other parts and views of the vehicle. Every model covered here can readily be viewed in its entirety elsewhere, but this is the only comprehensive report done from the perspective relevant to the driver and vehicle lighting and vision community.

The Los Angeles auto show is clearly the *real* international auto show in North America. It is markedly bigger and better-attended than the Detroit show, both by exhibitors and by spectators. In today's automotive world, the hot zone for North American innovation is in California and the west, and that shows in the shows. It was especially interesting to see these two shows almost back-to-back. Their nominal focus is not identical, of course; LA is first and foremost an auto show, whilst CES is a technology show. But there's a whole lot of overlap: the LA show had tremendous deliberate and incidental emphasis on technology, because today's cars contain an unprecedented amount of it, and CES had a great deal of deliberate and incidental emphasis on personal transport.

This year we bring you an unprecedented number of big, sharp, full-colour images—322 of them. Where warranted, we provide multiple views of the same subject from different angles, annotated and described with text. In the first section, covering the LA auto show, vehicles are presented alphabetically by marque. In the second section about CES, coverage is alphabetical by exhibitor name.

Not much doing in the way of what we used to think of as concept cars. The function and role of the concept car has changed fundamentally, as it seems. It's still possible to find ones that primarily serve to tease forthcoming designs and styles, but for the most part they've moved on to test out whole new ideas in automotive transport. The fundamental assumptions of how the traffic system works are almost all open for active reconsideration, up and down its scale from macro to micro and back again. And while concept cars like the Mercedes Vision Urbanetic might look just as imaginative as yesterday's styling flights of fancy, now we're at a point where there are credible levels of both feasibility and plausibility not only in the car itself, but also in terms of public acceptance.

We have passed the big tipping point: LEDs really have to be considered the standard technology for making light on cars. Incandescent bulbs may still predominate worldwide on account of their ultra-low price, and they can still be found even on some clean-sheet new cars, but the galloping pace of LEDification can't be denied and is still increasing. Interestingly, LEDs are not only marginalising incandescents at the low ends of the market, but also threatening at the high end to relegate OLEDs to low-volume niche cachet applications.

North America is one of the world's only markets—and certainly the world's largest—that doesn't recognise the international UN (formerly "European") vehicle lighting regulations. That means there are differences in the American-spec lighting system configurations of models sold round the world, and it also means American homegrown lighting systems have evolved from a different set of genes. It's interesting to see how the international exchange of ideas is creating a truly international industry race for more and better lighting content and design. LED DRLs are fast on their way to becoming expected (if not quite yet standard) equipment, even though U.S. regulations don't require daytime running lights of any kind. Rear turn signal colour is still a matter of style rather than a matter of basic safety specification in this market, but a proposal to award NCAP points for yellow rather than red has spurred novel turn signal designs on high-volume models. Automakers are finding significant traction in the use of lightstyles for brand identity and vehicle family cohesion. And while the effects of IIHS headlamp performance testing might not translate directly to observable changes in lighting system design, its influence is broadly present in terms of increased attention to the functional aspects of the road-illumination devices on vehicles. You'll find more detail on all of this in the pages you're about to view.

# Los Angeles Auto Show

The Los Angeles show is massive. Maybe not Frankfurt-level massive, but still, it took up multiple halls and involved a goodly majority of the automakers involved in the North American market. There were many makers present at Los Angeles who skipped the Detroit show a month later, but only one maker we can think of did the opposite: China's GAC, with their regrettable-in-America Trumpchi vehicle marque, showed in Detroit, but not in L.A.

At Los Angeles, though, we saw Rivian and Byton. Their trucks and cars, respectively, appear to be racing resolutely toward readiness, and we've presented an editor's-eye view of the progress they're making as gauged by the lighting and vision systems.

For the matter of that, it's how we gauge and describe all the makers' vehicles in this report. We attend these kinds of shows on industry-preview days—that's the way to get sufficient access to scrutinise and photograph what we're there to see (neither hindered by the hordes during the public days, nor kept waiting for each and every model to be unveiled at the end of a lengthy, theatrical dance routine during the press days). It's also illustrative, for while we're busily scrutinising the lights, ADAS, and AD componentry, we're in good company: others are just as busily taking notes on the seatbelts…the glass… the paint…the sound system…the upholstery…the brakes. There's an expert for seemingly every imaginable aspect and conceivable component of the automobiles on display.

This what you're now reading is the product of your eyes on the ground at the show: your Driving Vision News. Let's walk the show, shall we?

The ILX has a trim, sparkling new rendition of Acura's familially identical lighting equipment design. The front combination lamps contain seven square ice cube elements; the outer four provide low beam, and the inner three are for high beam. The DRL is a prominent, stylised checkmark tapering inward, with a tidily integrated triangular side marker at its outboard wall. The turn signal is a slim, ribbed light guide spanning the top of the lens.

Lower down in the bumper fascia is the LED fog lamp, with three ice cubes in a row suggesting the spear to an arrowhead-shaped nacelle with a chrome boomerang at the inboard leading edge.

The rear lamp sings harmony with the headlamp; the reversing lamp is served up on the platter of the inboard portion of the tail light, shaped similarly to the DRL but with a hint of a tailfin at the outboard upper corner. The turn signal is amber, but contains an incandescent bulb.

The RDX bears its own version of the Acura lighting signature. It's another rendition of the arrangement with seven ice cubes, but here the DRL is a slim light guide, and its checkmark shape isn't tapered, but does zig downward at the corner. There's a well-packaged side marker, and  the turn signal is like that of the ILX.

The RDX rear combination lamp is interesting and elegant. No checkmark here; instead, The incandescent amber turn signal and the reversing lamp provide the negative space to accentuate the prominent fish-hook shape to the tail lamp. Textural optics fill the side panel of the lamp, fairing it into the quarter panel with the impression of machined metal painted in light.

The RLX has Acura's "Jewel Eye" headlamps, with their folded optical path in the twinned over/under lens elements. There's a stylised version of the Acua checkmark DRL presenting as a lower eyelid, with its outboard side face striated to create a sculptural effect, with  the triangular side reflex tucked under its wing and the sidemarker light tucked just above.

At rear, the checkmark gains whimsical curves as it frames five streamlines of red light spanning from the quarter panel to the decklid:

## Audi

DVN regularly reports on the steady stream of technical developments from the light magicians at Audi, but it's at motor shows where the design innovations call shining attention to themselves. This year Audis have a new way of providing their sequential turn signal. As seen here on the A7, activating the turn signal causes the whole array of toothlike elements to illuminate in amber at low intensity, and then each intensifies in sequence, inboard to outboard, to provide the sweeping turn signal. This way there's no doubt that the American requirements for lit area are met immediately on activation.

## Audi, cont'd

The A7 rear lamp presents as a sandwich of light. The upper part contains whale-tooth elements like the front turn signal. There's a very evenly luminous red line spanning the full width of the car, and under that is the linear element of the turn signal, also red, which illuminates in the sequence shown here.



## Audi, cont'd

The A8's lamps have the expected high-tech character. The sequential front turn signal works on the same principle as that of the A7; it's a horizontal light guide that lights up entirely in low-intensity amber as soon as the indicator is activated, then the high-intensity amber section grows from inboard to outboard until the whole thing is bright, then it switches off and the cycle begins again.

## Audi, cont'd

The A8 taillamp is a multilayered marvel. It's capped by a full-width red line with a hook at each end. The main attraction is a set of four L-shaped sculptures with prominent OLED structures. These become 3-D light bricks for the stop and turn signal light functions, while a bright red dotty LED section below them lights up as well.

The Q8 rear lamp has a colonnade appearance with 12 gracefully arched elements capped by a slim light guide providing sequential illumination for the turn signal.

## Audi, cont'd

The Q8 has the new front turn signal strategy realised with nine whale-tooth elements. They all light up in dim amber light as soon as the indicator switch is flipped, then the bright amber marches sequentially outward:

## BMW

The new BMW 3 brings an interesting new twist in the evolution of what started out as the twin-ring "Angel Eye" appearance. No longer rings, now there's a pair of J-hooks in white light and a light guide eyelid—which goes amber for the turn signal—spanning the full width of the headlamp assembly. The light chambers themselves have a high-tech appearance, complete with a don't-stare-into-the-laser-light warning label.

The 3's rear light is a four-element stack of light: a prominent 3D hockey stick for the tail light, and three dotty red layers for the stop and turn signal functions.

We can see familial similarity—but not identicality—in the X4 rear light. The hockey stick and stacked layers are present, and everything's done with red light, but it's different enough to discern the models.

## BMW, cont'd

The X4 also shows similar-yet-unique design in the front lights. Note the eyebrow turn signal, the dual open-hook white light guides wrapping four sides of a hexagon around each of the projector + reflector headlamp chambers, and the four-shovel LED fog lamp down below:

There's a "BMW ADAPTIVE LED callout near the front side marker light, and we can see the extraordinary depth of the white light guide:

On the 850i here we see another rendition of these same forms, with enough difference to make it readily differentiable. There are blue styling elements, a laser-warning decal, lozenge-shaped lenses in the upper and lower portions of the light chambers, and an evenly-illuminated light guide up top for the turn signal, with the side marker light integral at its trailing outboard end.

The rear lamp on the 850i ties in with the BMW family at large without looking just like the one on the 3er. There's a prominent red swinging line with a wide blade at its outboard edge, and two multi-dot red arrays providing the stop and turn signal functions. Reverse and rear fog lamps are discreetly hidden at the lower inboard corner:

The X5 lamps likewise paint from the same palette. Here we're moving away from scoops or hockey sticks, with more of a wraparound-sandwich effect, but the stacked dotty layers and all-red light remain:

## BMW, cont'd

The X5's front lamps present with blue styling elements reminiscent of X-Wing Fighters from Star Wars. Here the side marker light and reflex is in the bumper fascia, rather than integral to the lamp.

And the X7's front lamp is perhaps the most fashion-forward version of them all. The blue X-Wing Fighters are more prominent, while the position/DRL fish hooks are horizontally elongated:

And here are the X7's rear lights, hewing to the family design and using red light for all functions:

This 3-Series sideview mirror incorporates a light guide repeater and a very tidily integrated camera; this arrangement is typical of present BMW design:

The BMW Motorrad (motorcycle) people joined in the fun, as well. The S1000 has a pair of LED projectors providing an aggressive appearance:

And here's the R1250 headlamp, which shows multiple projectors and reflectors as well as a light guide for the front position light and perchance the DRL:


The R1250's rear lighting system is a bit of a study in contrasts: the central stop/tail lamp is a nicely styled LED item with waffle optics; below it is the rear reflex. The turn signals are old-fasioned small incandescent items:

## Buick

Buicks have had interesting and classy lighting for awhile now, largely on strength of their Opel roots. Now GM have sold Opel to PSA...so what does that mean for Buick? In the short run, at least, no big change; PSA will carry on building at least some Opel-based Buick models on contract for GM. Other Buicks are coming from China, where the brand enjoys a de luxe reputation.

The Encore's base headlamps are halogen items with the Opel/Buick twin extended chevron for the DRL. The upper chevron changes from white to amber for the turn signal.

That same arrangement is used on the Encore's upgrade headlamps, which are triple-chamber reflector LEDs.

The Encore rear combination lamp is a tidy affair with an amber incandescent turn signal forming a square island surrounded by the twin red LED chevrons of the stop-tail lamp.

There's tasteful chrome framing providing depth and visual fascination, and the design is appealing no matter which lights are lit.

Perhaps this, on the Envision, is the next phase of the Buick lightstyle: a *single* thick chevron instead of two slim ones for the DRL, with a bullnosed BiLED projector framed by a sculptural chrome chevron, and a prominent toucan's-beak turn signal:

The Envision's rear lamp has a pleasantly homogeneous waffle-optic red LED hockey stick overtop an incandescent amber turn signal:

## Buick, cont'd

The LaCrosse headlamp has a set of elements similar to those in the Envision, but with more difference than is seen, for example, in BMW's model-to-model variants of the family light design. Here the projector is round, with a squircular bezel and hoop-shaped chrome fascination element on the floor.

The LaCrosse rear lamp is a simple all-red setup:

The Regal has an Opeloid design with two thin chevrons—both white for position/DRL, amber for turn—above two inner square and one outer round optic.

The Rega tail light, too, speaks of Opel origins, though while there's no amber turn signal here...

...there is a classic-type turn signal repeater, mounted on the fender rather than the sideview mirror. It contains an incandescent bulb and a prominent chrome shield, reminding that while some repeaters provide nearly a 180° spread of light, the UN Regulations require only a 50° spread, starting at 5° outboard from straight-rear.

## Byton

Byton's work-in-progress Kbyte has a front lighting mockup suggesting a three-element headlamp with multiple full-width light lines that could be used for status indication or other functions.

Likewise at the rear: multiple red fine lines above, a single thicker one below capped at both ends by a stack of blocks.

There's also an intriguing longitudinal roof light that looks like it might be a place holder for new kinds of lights we're sure to see on AVs, sooner or later.

The Mbyte's lighting is futher along in development, showing actual projectors set into blackout nacelles in the lower part of the bumper fascia; up above on each side is a trio of high-brightness LED blocks.

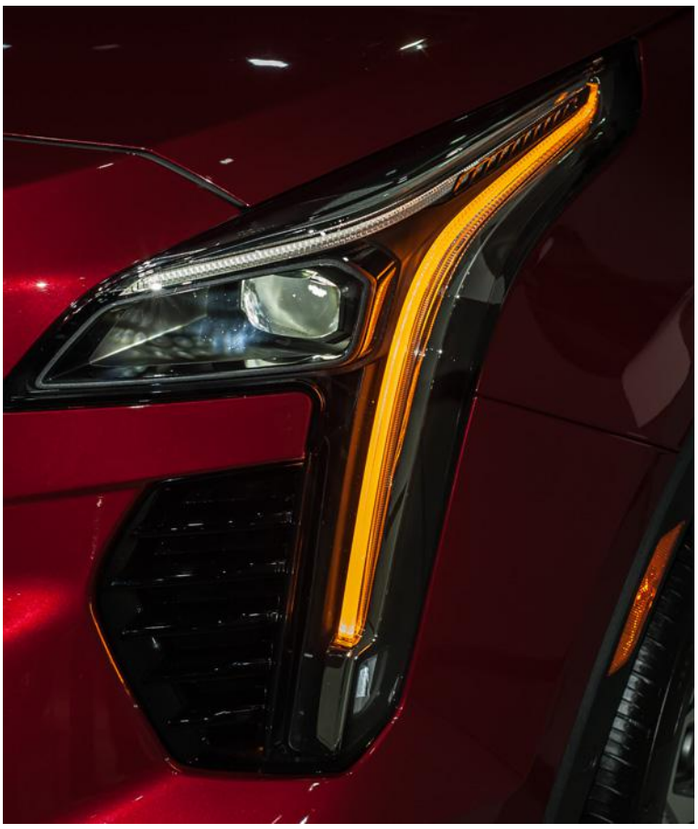
Which lights do what function? Too early to tell. Fine blue-white lines crisscross the fascia below the triple elements.


The rear lighting looks production-plausible, with an almost exclusively horizontal theme and an echo of the crisscrossing fine lines.

## Cadillac

Cadillac's lighting has been converging on a family brand identification, and it's growing into BMW-like levels of coördination. The CT6 front lighting package is trim and elegant. Twin LED projectors (and a discreetly hidden cornering light) are tucked under a sculpted-metal hood and framed by a chrome hockey stick. Outboard, there's a graceful waterfall element providing white position and DRL and amber turn signal functions. The side marker light and reflex are at the forward edge of the wheel arch.


The CT6 rear light is a multi-element artwork with an outboard staircase of light, a ribbed longitudinal light guide, and a fancy pinhook pointing inboard with sculptural fine lines on its outboard face.



The XT4's front lighting package carries themes similar to the CT6, with the prominent outboard waterfall element providing the DRL, position, and turn signal functions—white and amber modes are both shown here. There's a framed BiLED projector, and the side marker and reflex are in the front wheel arch.


The XT4 rear lamps have a sweeping L-shaped light guide for the tail light function, with a tower of ice cubes that turn red for the stop and turn signal functions. Two emitters power the integral side marker light and reflector.

The new Blazer Premier has a round bifunctional projector above a small arrowhead-shaped turn signal, both in a nacelle well below the bathtub-shaped dotty DRL.

The Blazer Premier's rear lamp has a pair of flying-dart shapes pointing inboard. All functions are red.

Viewed side-on, the dart shapes in the Blazer Premier's rear lamps give a prominent depth effect, and there's subtle identification at work: the rear side marker light is shaped in the Chevrolet bowtie brand logo.

The newest Camaro has a bifunctional projector with round sides and flat floor and ceiling, outboard of a reflector-type amber turn signal which also lights up a light guide-like inward extension.


The Camaro tail lamps are modern in construction, classic in design, and retro in function: they're round-sided oblongs with red-ring perimeters. The stop and turn signal functions are done by the same red light, filling the field of the outboard lamp. The corresponding area of the inboard lamp is an incandescent reversing lamp.  A special dark version is offered as an accessory.

The Equinox front lighting package has a BiLED projector and a small curved white LED DRL up top. Down below in a nacelle is a halogen fog lamp and incandescent turn signal.

The rear light is conventional in design: a thick red curve and line for the stop/tail/turn, with a clear-lens section that could be used to provide an amber turn signal...but isn't.

The new Silverado 1500 pickup offers a triple-reflector LED headlamp (outer two for low beam, inner for high beam) , a slim turn signal well below, and a staple-shaped DRL tying the elements together.

The Silverado 1500 rear lamp is a straightforward candlestick or vase type of design, with all functions in red except the white reversing lamp.

Chevy's heavy-duty Silverado 6500 truck, on the other hand, gets perfectly basic, all-incandescent front lighting.

The Suburban comes in somewhere between the small and big Silverado trucks: here there's a projector low beam and a white LED DRL. High beam and turn signal are incandescent.

The Suburban rear lamp does everything in red, with bulbs.

On the Chev Traverse there's a bifunctional round projector with a heavily textured lens, a curved linear white LED DRL, an incandescent turn signal, and down below there's a halogen fog lamp.

The Traverse rear lamp is awash in texture: there's a smooth texture to the red element, while the clear elements are stippled and ribbed.

Although repeaters are (still) not required in America, the Traverse has them, built into the side mirrors.

## Dodge

The Challenger has an interesting design feature in its headlamps: the inner lamp, which has LED rings providing DRL and turn signal functions, has a laser-etched brand identity design in the inner bezel. Varroc's wizardry here allows rapid, cost-effective variety to the etched designs for limitless branding and marketing opportunity—trim levels, special models, customisation and personalisation, and so on.

The 124 Spider has a front lighting package that makes use of design techniques to mimic LEDs: the sidemarker is incandescent, but hidden behind a rounded-triangular ribbed ring that looks like it contains LEDs.

And the rear lights have an incandescent turn signal, but there's a blankoff plate hiding the bulb so the clear-lens ring emulates a ring of LEDs.

The 500X boasts a full-LED front combination lamp, complete with a callout to that effect. It's got prominent eye-type styling, echoed down below for the turn signal.


The rear lamp has an outer thick red ring around an amber turn signal ring.

## Ford


Ford put an unusually large amount of emphasis on advanced driver assistance and safety systems, such as this poster for what Ford call "BLIS", that is Blind Spot Information System.

The Ford Edge's new front lighting package is a painting in white and amber: a prominent side marker light and reflector backstops an arch-shaped light guide covering the LED headlamp optics. A ribbed LED array at the front of the floor provides the turn signal.

Down below, in a bumper fascia nacelle, there's an LED fog lamp.

The Edge rear lamp is a fresh version of the over-and-under shovel optics, half amber and half red, with a thick, boat-shaped red element for the tail and rear side marker functions.

There's also a dotty LED repeater in the side mirror.

The gradual evolution of the F-150's lighting package continues: now there's a high-luminance, very small LED turn signal. The side reflex is hidden behind a machined-metal-looking inner wall of the lamp. Headlamps are still the small rectangular LED units.

The F-150 rear lamp now has two red frames, one above and one below. The central area of the upper square provides the stop and turn signal light functions in red; most of the lower square is taken up by the BLIS sensor, but the inboard portion is reserved for the LED reversing lamp.

The Mustang gains an LED amber position/turn signal light, while a new version of the triple-stripe embellishment sits inboard of the bifunctional projector. Side reflex is integral.

The new Ranger's base headlamp is an all-incandescent setup with reflector halogen low and high beam and a bulb-type turn signal.

Higher-spec models get a BiLED projector in a squircular bezel and a swinging-line white LED position/ daytime running light, but keeps the bulb-type front turn signal.

The Ranger taillight contains a more intricate version of the framing theme found in the F-150 tail light. And, like the F-150 light, it has a built-in BLIS sensor. But this time there's a prominent C-shaped red area providing the stop light function, and surrounding a vertical oblong area that provides the LED amber turn signal while coördinating with the smaller vertical oblong below, that is the reversing lamp.

There's a RANGER callout designed in:


Ranger side mirrors, at least optionally, contain repeaters, which in turn contain 5-watt incandescent bulbs.

## Genesis

The G70 has an attractive front lighting package evincing an animalistic form: the eye-ringed BiLED projector, the LED light guide DRL snout above optical teeth, the side marker ear, and the turn signal neck:

There's a great deal of designwork in the G70 rear lamp, as well, which is pleasing from any angle. Viewed side-on, there's a chevron-shaped light guide side marker light capping the reflex, below a GENESIS callout:

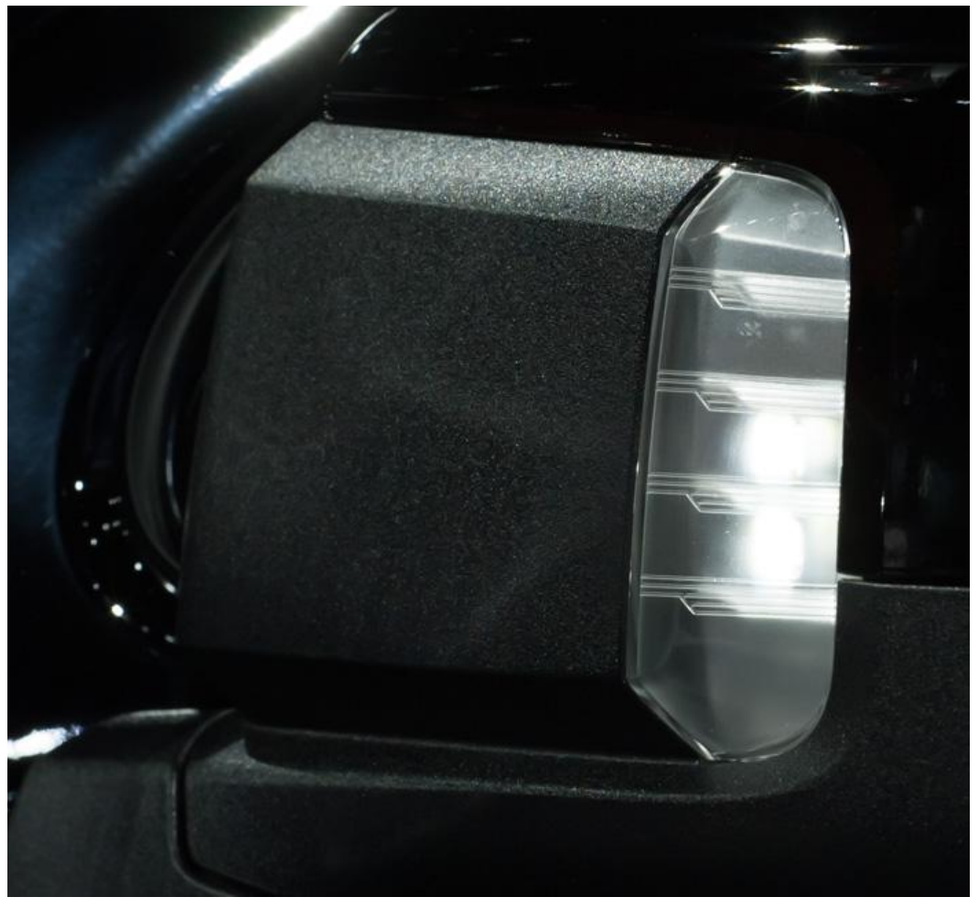

From more of a rear view, we see the racetrack-shaped, evenly-lit tail light guides above the bulb-type amber indicator, which in turn is outboard of the bulb-type reversing lamp:

Step on the brake, and the three towers within the racetrack light up bright red, with a fascinating stippled pattern on their rearmost surfaces.

The new Sierra 1500 has a triple-reflector LED headlamp like its Chevrolet Silverado counterpart, but here the reflector chambers are stacked rather than side-by-side. There's an LED shovel-optic turn signal inboard of the uppermost low beam reflector, and the whole collection is framed by a large white LED DRL/ position light. Side marker is integral.

The Sierra has vertical oblong LED F3 fog lamps with the increasingly-popular nacelle treatment in the front bumper fascia.

And there's new lighting content in the Sierra's sideview mirror. GMC call them "ground lights", and they light the area close to the truck.



They're controlled by a button (indicated here by a red arrow) on the highly-multifunctional light switch.

The Sierra rear lamp is all red, with a mix of frosted and clear lens materials creating a multilayered depth appearance in the 3/4 and lateral view.

In straight-on view it is reminiscent of the taillamp used on Ford pickup trucks of the 1970s:

## Honda

Honda's Clarity has its own version of the Honda lighting design theme: horizontally wide, vertically slim multi-reflector LED headlamps with a thin turn signal light guide above and an L-shaped DRL/position lamp.

Different versions of the Clarity get different rear lamps: a de luxe version, colourless when unlit, or a more conventional red/white setup.
Both are shown here.


The Insight, too, hews to the Honda lighting design theme. Compound curves and interesting internal angles complement the chrome spear tying left and right lamps together across the front of the car.

The LED fog lamp comprises five ice cubes down in the bumper fascia.

In back, there's a boat-shaped red light guide for the tail light function. Stop (red, below) and turn (amber, above) functions are done with bulbs.

The refreshed Pilot has familial headlamps...

...tail lamps with a colourless central section for an amber turn signal this year, rather than red...


...and incandescent door lights:

A streamlined version of the Honda headlamp, this: the multi-shovel optics, the hook-shaped position/DRL array, and the integral side marker—and nothing more.

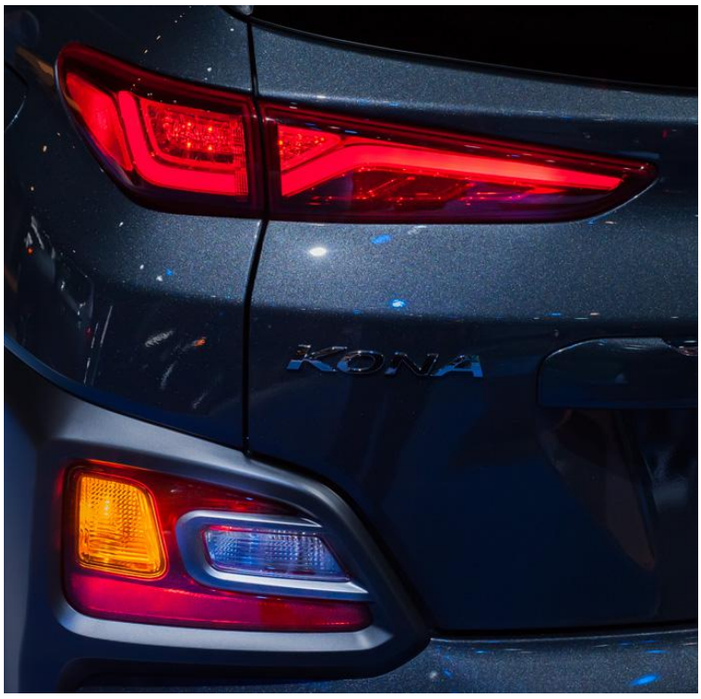
The Passport rear lamp is very much like the one on the Pilot:

The Elantra's front lighting is highly triangular. The four projectors are squircles, but everything else is triangular, from the headlamp housing to the (bulb type) turn signal down below.

Shapes are a little more diverse in back, with an interesting pair of red light guides for the tail light, a dotty red array for the stop light, a neatly packaged amber bulb-type turn signal, and sculptural integration of the side marker.

The Kona's basic-equipment headlights are halogens. Higher-trim models can be had with LED headlamps which, since revisions were made in the middle of 2018 production, now earn the OK from IIHS (prior to that they were rated as too glaring). The side reflex is on the outboard wall of the headlamp nacelle. Above the headlamps: the LED DRL/position light, and the small turn signal.

The Kona rear lighting package is divided into two, like the front lamps: the red stop and tail lamps are above the the reflex reflector (hoop or line, depending on trim), bulb-type turn signal (with colourless or amber lens, depending on trim) and the reversing lamp.

The Nexo has a bifunctional projector in a triangular, black nacelle. Above that is an attractive LED sandwich: white DRL "bread" and amber turn signal "filling".

The rear lamp is triangular. The outer red bands form the tail light function, while the inner dotty space lights up all in red for the stop and turn signal functions.

Even the repeater, built into the side mirror, has a triangular styling effect.

The Palisade has a big, imposing lighting package. Over-and-under projectors are flanked by a giant white light strip flowing vertically and bisecting the multi-shovel LED turn signal. The side marker light is stylistically tightly integrated with the turn signal.

There's a FULL LED SYSTEM callout between the projectors.

The Palisade's rear lamp, too, is big, bold, and blocky. Two red blocks and one amber, with one vertical and two thin horizontal light guides forming a flagpole-shaped tail light.

The outboard side of the rear lamp bears fine red lines adding a sculptural effect.

Even the repeater gets the "big" treatment:

The new Santa Fe has a stacked pair of headlight projectors above a bulb-type turn signal. There's a small LED fog lamp tucked down below in a nacelle, and a pair of triple-section lights (DRL?) ringed and separated by white light guides.

The rear lamps pull off a neat trick: they're cleverly designed to create a 3D tunnel appearance—in fact it's all done with creative 2D sculpting of the illuminated surfaces. There's an interesting concavity on the side flank. The bulb-type turn signal, reversing lamp, and reflex are down below.

The Veloster has an interestingly-shaped low beam projector, a halogen reflector high beam, a pair of seven-dot LED position/DRL arrays, and amber triangles inboard and outboard.

In back it's got three flying darts, six red fields, and a bulb-type amber turn signal.

The QX30 front lighting package includes a headlamp with graceful curves inboard and outboard of a glittering headlight projector. The triangular side reflector looks like it belongs, and the side marker light carries from the DRL's line.

Down below, there's a multi-element LED fog lamp.

The QX30 rear lamp is framed by the same curved themes found in the headlamps. All functions except the reversing lamp are done in red light.

i-Pace

Here's how the i-Pace looks in American-spec trim. The front turn signal is done by most of the total surface area of the L-shaped arrays framing the compact oblong headlamp beam contributors.

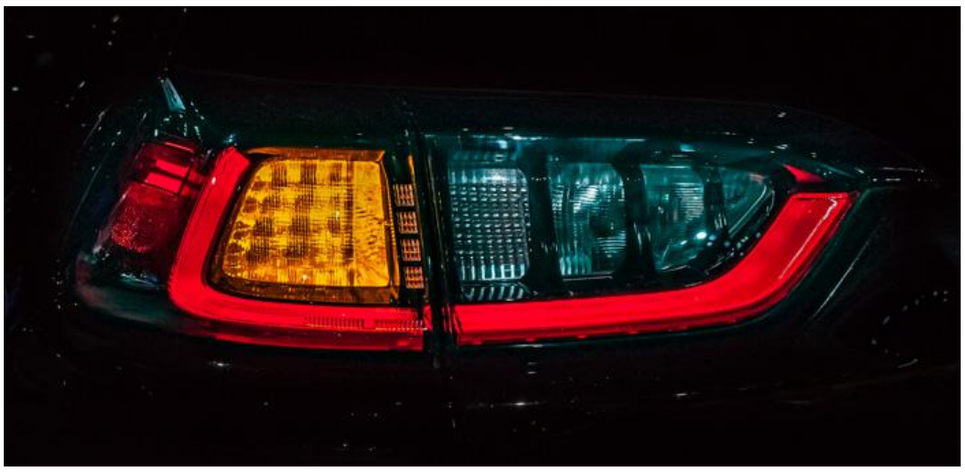
The side marker and reflector are tucked neatly into the sidewall—above it, there's a JAGUAR LED TECHNOLOGY callout.


The tail light is a red brick wall:

The Cherokee's headlamp has a truncated-circular projector, an inboard reflector, and an interesting frosted-texture finish to the turn signal cover, which swoops outboard. The side marker is integral.

There's an LED fog lamp down below.

The Cherokee rear lamps light up a trapezoidal field in red for the stop function, and that same trapezoidal area in amber for the turn signal. While the turn signal is operating, the stop lamp is defeated so there is no red/amber/red/amber flashing. This arrangement would not be legal under UN Regulations, but it's finding favour in the American market as it can reconcile the requirement for 50 $cm^2$ of lit area with the deisre for small overall lamp packaging.



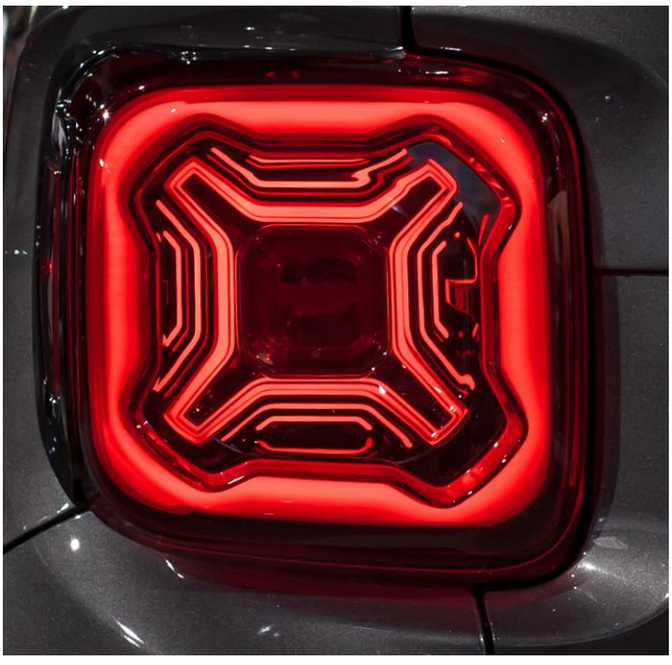
The Gladiator is the new truck-bodied variant of the new Wrangler introduced last year. It's got the same lighting package, featuring great big round headlamps about 230mm in diameter—reflectors with H13 bulb as basic equipment, or technologically sophisticated LEDs (shown) as an option.

The tidy upgrade front signal light has a row of amber emitters for the turn signal and a row of white ones for the position/DRL functions; the side marker wraps round the side.

The Renegade can be had with an LED headlamp thematically similar to the larger unit on the Wrangler and Gladiator, with a PERFORMANCE LED callout on the central shelf. The lowermost chambers are for extra high-beam punch. They're live on the US/Canada version in a bid for a good IIHS rating, but oddly, that section is blacked out and not used in the ECE version—even though European drivers expect strong high beams.

The Renegade's turn signal is still an incandescent bulb, but there's a small projector-optic LED fog lamp down below.

The Renegade rear lamp is an intricate artwork in red lines, with a subtle Jeep logo in the middle.



## Karlmann

Only in America, eh! A Karlmann King is the $3.8-million result of rebodying a Ford F-550 truck. It looks something like a death star on wheels, with triangles everywhere on its semi-matte black exterior. Its lights match that styling theme: triangles everywhere.

The Forte's headlamp has an organically-shaped headlight projector with a textured lens, flanked by four white LED DRL wings. The side marker fairs the lamp into the fender, the bulb-type turn signal is a horizontal line at the top of the outer nacelle, and the round fog lamps are inboard.

The rear turn signals share the styling of the front ones, and they're in a triangular pod with the small reversing lamps. Above, the tail light guides look like a waveform on an oscilloscope.

The shelves separating the single large upper and dual small lower projectors in the K900 headlamp are fronted by light guides.

The lower one changes from white to amber to provide the turn signal function.

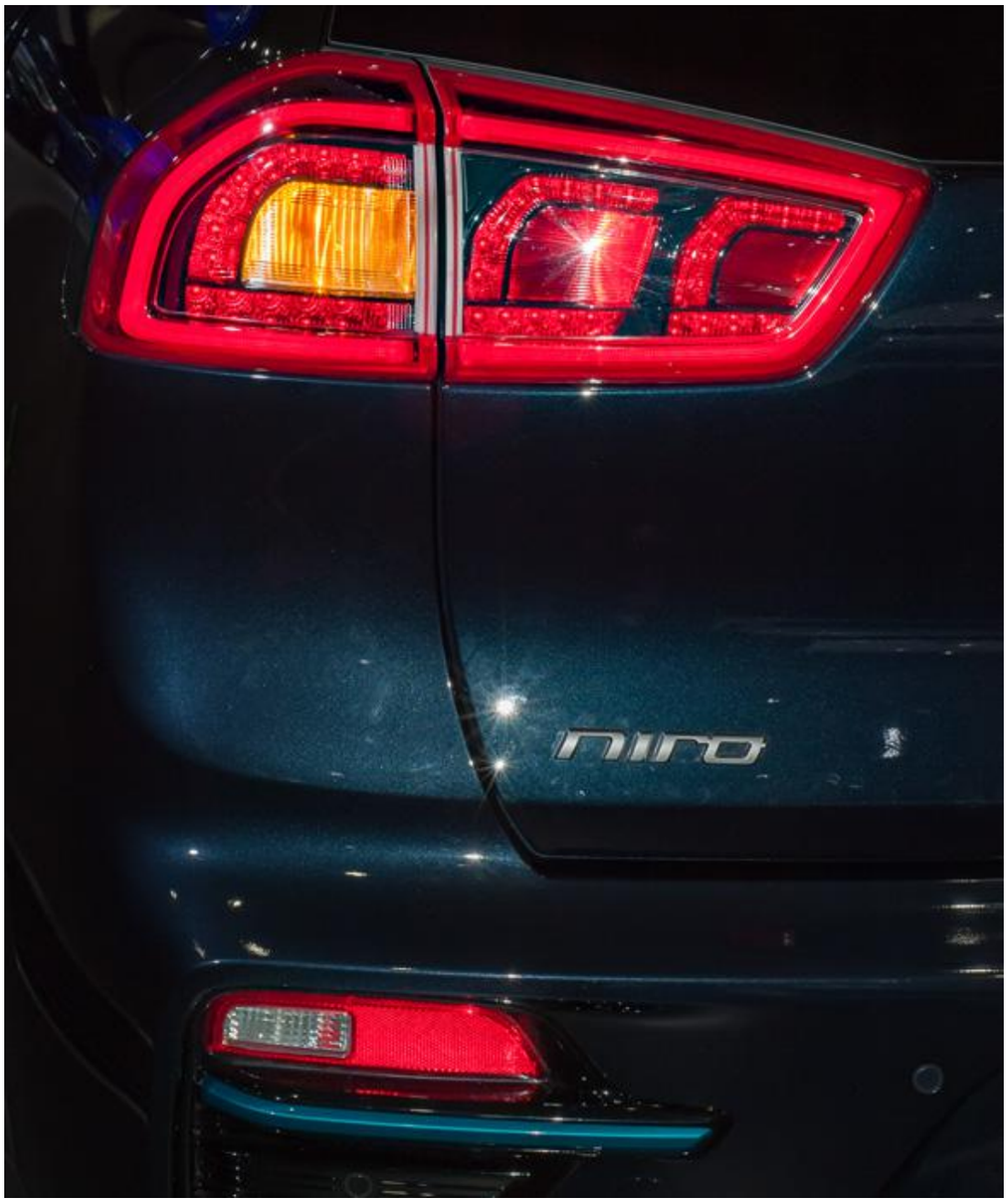
From the rear, the K900 tail lamp appears dignified, with red-front shelves creating a layered effect and vivid, homogeneously-lit coloured segments.

The design really reveals its intricacy from off-axis angles, where the multifaceted thick light guides become apparent.

The K900 mirror repeater has a nice stippled texture.

The Niro's twin-projector headlamp has a J-hook turn signal outboard. Down in the bumper fascia is the round fog projector outboard of the DRL, which forms the two wings of an airplane shape.

The Niro rear lamps have a trio of red arch-and-plate shapes for the stop lamp, ringed by a red light guide for the tail function. The outer covered-plate shape serves up the amber bulb-type turn signal. The reflex and reverse light are down below.



On the Sorento, a prominent dots-and-lines linear turn signal underscores a trio of LED headlight projectors surrounded by sculpted metal.

Viewed from above, the elements swap prominence, with the projectors coming to the fore.

The rear lights have a fish hook light guide and twelve red teeth, all above an amber bulb-type indicator. Side marker is integrated outboard.

Kia's new Soul has cutting-edge or retro-tech headlamps, depending on model. The bright lime green car shown here is the EV, which shares a front lighting system with high-spec fuel-burning models: a fancy array of four LED headlamp emitters up above, with a linear side marker light outboard, and an LED fog lamp and DRL in the lower nacelle...

...while this dark green car is a base model. It has H4(!) headlamps in the lower nacelle, and bulb-type turn signal, DRL, and sidemarker up above:

The Soul's rear lamps are an interesting big-loop wraparound design. All the red functions are in LED technology; the amber turn signal and white reversing lamp are done with bulbs.


The new Telluride has a big rectangular amber turn signal shown here serving the DRL function as it surrounds over/ under stacked headlamp projectors.

The Telluride's rear lamps are an all-red design with two prominent bent-line light guides mirrored by the integral side marker.

The Range Rover's rear lamps present a big-squares-in-two-colours theme, with the side marker accentuating the fair-in to the quarter panel.

On the Range Rover Sport, the thick light guides at the front of the headlamp evince hand-carved craftwork, while whale's-tooth structures on the floor point aft at the slim ice cube headlamp optics.

The Range Rover Sport rear lamp has a high-depth, evenly-lit cup holding an octet of shovel optics. All functions are done in red light for the American market.

## Lexus

The Lexus familial DRL looks more like a fish hook in its newest iteration on the ESh, with the barb pointing at the BiLED projector. The turn signal, surprisingly, is a bulb-type item.

The rear lights have a trio of red L-shaped lines retreating to the vanishing point as they sweep inward. A bulb-type amber turn signal is outermost.

## Lexus, cont'd

The IS rendition of the Lexus lighting look has three checkmarks splayed so as to create an eye-catching 3D appearance. Turn signal is provided by an amber bulb.

The Lexus LC Concept presents with a fresh assembly of familial lightstyle elements. There's the checkmark-shaped DRL, here with its tail hooked as well. There's the vertical-line turn signal defining the front of the fender blade. And there's a trio of trapezoidal LED headlamp emitters in a triangular nacelle. The side marker is in the wheel arch.

## Lexus, cont'd

The LC Concept rear combination lamp has a nifty infinite-tunnel effect to the stop/tail lamp section when it is lit; when unlit it's a mirror. The turn signal is a downward line defining the rear of the quarter panel, consistent with the front one.

The Lexus LS front lighting package gives new meaning to the term "Z-beam". The DRL checkmark splinters off into three lines, one pointing to each of the three triangular headlamp emitters. The turn signal is tucked just above the checkmark's main line.

The rear lamp has six (count 'em!) red L-lines: three thick outboard merging into one as it flows inward to underline the three inboard thin ones. The turn signal is a slim yellow line beneath.

The UX mixes things up a little: here the checkmark DRL migrates from the bottom about ¾ of the way up the lamp, where it serves as an eyelid for the BiLED projector and incandescent turn signal. The integral side marker light and reflex capitalise on the triangular outer-wall profile of the front cover lens.

The UX rear lamps are very compact, and tied together by a full-width red line. They form a small but definite tailfin at the top.

The Aviator's front lighting package, LED through and through, has two rounded-oblong projectors above a hook-shaped slim light guide. There's a 5-segment lamp tucked below that—a cornering lamp, perhaps?—while the linear light guide turn signal is all unto itself. A four-optic LED fog lamp is down in the bumper fascia.

The Aviator rear lamp is a trim, elegant three-colour sandwich capped by a very evenly-lit red tail function. Below that are two sections both colourless when unlit: the middle one lights up red for the stop lamp, while the lower one is amber for the turn signal.

The colourless sections carry into the hatch gate, with the lower one containing the two-emitter LED reversing lamp, while the red band at the top spans the gate.

The new Navigator headlamp puts forth a high-tech face: projector eyes above a row of teeth set off by two dotty arrays. The turn signal is its own horizontal light guide well below the headlamp.

## Mazda

The new Mazda 3's headlamps bring an updated, refined version of Mazda's angry-bird lighting look. There's a prominent round ringed-and-lidded LED projector eye, with embellishments of carved metal and retroreflective amber plastic.

The rear lamps are an intriguing four-eyes arrangement of dots, lines, and rings. The inner group of four dots is for the reversing lamp; the outer group (and the edge line aligned with the outermost dot) provide the amber turn signal.

A slightly different version of the rear lamp is on the 3 hatchback—no outboard line for the indicator.

There's a prominent carve-out in the Mazda 3's dashboard for the HUD hardware:

The Mazda 6 headlamp is a different species of bird. Here the two DRL light guides form a beak (inboard) and ruff (outboard, together with the side reflex) surrounding the head (projector). A nicely frosted LED turn signal array caps the assembly and swings outboard, with the side marker light at its aft end.

The 6 taillamp has a prominent round red tunnel as its visual focus. It's divided up into wedge-shaped segments, like an exotic citrus fruit presented in a boat-shaped red light guide, and capped by a dark-when-unlit amber turn signal array.

## Mercedes

The AMG GT headlamp has a bold fish-hook DRL/position light enwrapping organically-shaped headlamp and cornering lamp optics. The largest projector lens is textured with a finely-detailed waffle grid. The side marker light and reflex are tidily integral.

Another AMG headlamp has a trio of shovel optics within the fish-hook, and three small emitters below:

## Mercedes, cont'd

Here we see two AMG cars' taillight styles: an extra-wide version of the Mercedes "hamburger" design on the white car...


...and an elongated fish-hook design on the dark blue car—note the rear fog lamp hidden in the reflex down below:

The C headlamp has an elegant design with a flowing-line DRL, two vertical beam contributors and an inboard partial-circular one with waffle-grid texturing, and a rounded-triangle side reflex at the outboard wall.

The C rear lamp has two rows of teeth within a double-red-line race track segment, and a horizontal row of teeth below. All functions are done in red for the US market.

In the CLS headlamp, an inverted checkmark becomes an eyebrow DRL. There are two organically-shaped projectors with a MULTIBEAM LED callout ahead of the inboard one, and an attractively integrated arrowhead-shaped side reflex.

The GLE headlamp has two rounded-square light guides separating the similarly-shaped projectors. The outboard light guide changes from whit to amber for the turn signal function. Here again, the fine waffle texture is evident on the main projector lens.

The GLE rear lamp contains two thick red light guides—outboard in the shape of a coupé roof, inboard a right triangle—enclosing a series of spoon-shaped reflector optics.

Viewed side-on, the GLE rear lamp reveals extensive depth effects and an interestingly-shaped side reflex.

## Mitsubishi

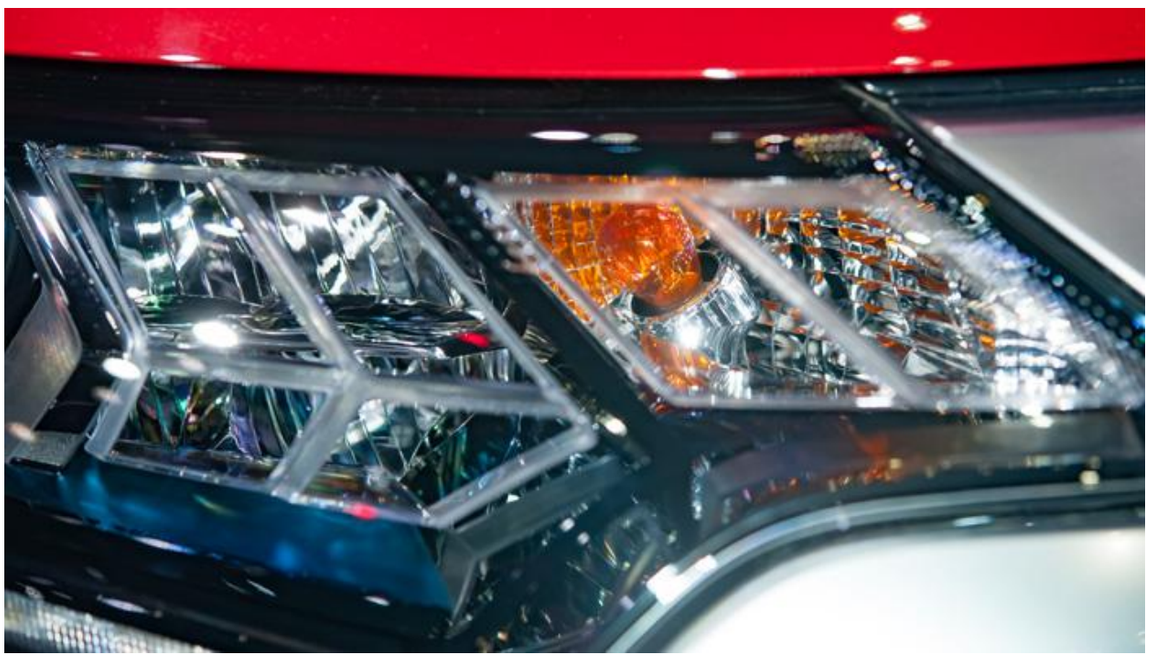
There's a lot going on in the front lighting design for Mitsubishi's concept car. So far the lights are just mockups, but their airplane-and-flying-wing shape is attractive and suggests complex optics.

The rear lights seem a little further along in their evolution toward production-readiness. They're an inward-pointing truncated dart, one leg of which juts upward into a—yes, really!—a tailfin:

There are two projector elements in the Eclipse Cross' headlamp: an inner truncated-round one, and an outer lozenge-shaped one with interesting horizontal striations. Down below, the bumper nacelle is filled with a bulb-type turn signal above a minimal halogen fog lamp.

The rear lamp aligns with designs seen recently on Honda and Nissan crossovers: a plump pear-shaped lamp with a red C-shaped tail light. This one surrounds a horizontally-striated bulb-type amber turn signal.

The Outlander's headlamp contains two round LED low beam projectors separated by pointy-fronted walls. There's a reflector LED high beam inboard, with a cross design at the front. Inboard of that is a bulb-type turn signal with a divided-window design up front.



The round fog lamp in the Outlander's bumper fascia is an LED unit with chipped-ice optics.

The headlamp on the Outlander PHEV has the two round projectors, but the high beam is a halogen unit, and there's a different design at the front of the turn signal window.

## Nissan

Nissan had a notable amount of promotional communication on ADAS in their show space—both large panels...



...and smaller, vehicle-specific signs:

The most prominent aspect to the Altima front lighting package is the thick sword-point DRL at the inboard corner of the lamp. The low beam projector outboard and the reflector high beam in the middle are grouped in an arrowhead-shaped chamber subdivided by chevrons. Down in the bumper nacelle is a bulb-type turn signal atop a round LED fog lamp in a blackout bezel.

The Altima tail lamp has multiple big blocks within the overall shape. The side reflex carries the main stop/tail section round to the side of the car, and there's a refreshing return to an amber lens for the turn signal.

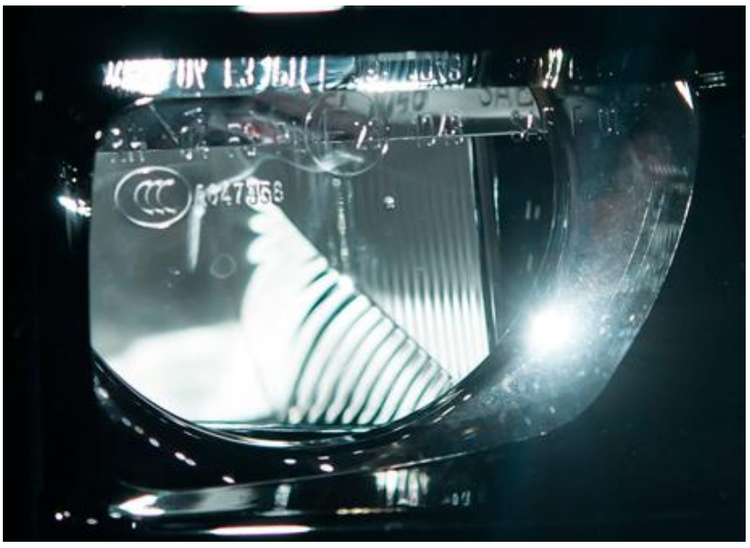

The Kicks front combination lamp has a chevron-shaped DRL, a bulb-type turn signal, and a small truncated-circle projector. There's a neatly-integral side reflex at the outboard wall.

The Kicks tail lamp is conventional in design.

The top-of-the-range Nissan-branded sedan has a multi-shovel LED headlamp with a sideways-U-shaped DRL, the lower leg of which is just above a dotted array of turn signal emitters. There's a triangular side marker integral at the outboard wall. A miniature LED fog lamp hides in the middle of a black textured bezel in the bumper nacelle.

The Maxima taillight repeats the sideways-U theme in red, while two rows of teeth provide the main rear lighting functions.

The Murano headlamp has familial stylistic ties to the Maxima lamp, but with fewer, bigger shovel optics than the Maxima, and the DRL takes a boomerang shape.



Down in the bumper nacelle is a miniature LED fog lamp with interesting optics.

The Murano rear lamp ties in with the front via a red version of the boomerang element. One row of teeth is within the boomerang, the other below. The lower leg of the boomerang is carried around and forward into the quarter panel by the side marker.

## Nissan, cont'd

On the Pathfinder we see a pleasing downward-arrow DRL inboard, a bulb-type turn signal above a halogen high beam, and a small round LED projector low beam outboard.

The Pathfinder's rear lamp is basic: all red, and all incandescent.

## Ram

The Ram 1500 can be had with different kinds of headlamp, depending on the trim level and options specified. Here's the reflector LED version on the Bighorn trim, with prominent upper and lower DRL arrays and a semi-dotty amber turn signal light guide, all in semi-frost material.

A blackout-styled version of this same reflector LED lamp is also available, shown here on the Laramie-trim truck.

And here's the projector LED type: two horizontal ice cubes with a horizontal light guide spanning the top of the housing to provide white the turn signal and DRL/position functions, and a semi-frosted DRL at the lower outboard leading edge. The two light guides come together at the outboard wall, above and below the integral side marker.

Here's a Ram 1500 rear lamp, as viewed side-on. The reflex band rings the outer perimeter. Inboard of that is a homogeneously-lit red band for the tail light function. The two horizontal sections light up in amber for the turn signal or red for the stop light function (but not both at once), while the vertical reversing lamp is at the inboard edge of the blind spot radar cover.

The Bighorn-trim truck has an interesting turn signal repeater built into the side mirror: two LED emitters provide the rear-lateral light to make it an actual repeater, while internal optics wash some of the light forward to reveal the horizontal striation pattern on the lens.

The Laramie-trim truck gets a different repeater, with vertical striations and a RAM callout.

## Rivian

The unusually-styled Rivian R1S (SUV) has two vertical-oblong headlight pods, well below which are horizontal arrays. It's unclear how close these are to production-plausible, but for now this is the presentation.


Each pod contains four miniature round emitters...

...while each horizontal array contains three oval elements.

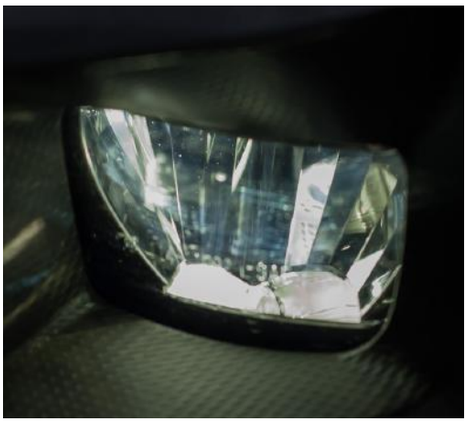
The rear light looks halfway between stand-in and serial. For now it's a homogeneously-illuminated red horizontal strip with surface texturing.

What might be the world's tiniest reversing lamp is hidden in the middle of the super-slim rear reflex. While there are no lit-area requirements for the reversing lamp function, implementations like this do make one pause in wishing for the abolition of US EPLLA requirements for stop and turn signal lights...!

Front and rear lights are similar on the R1T (Truck); here we see the whole of the rear lighting setup as currently envisioned:

## Subaru

The new Ascent presents with front lights in accord with Subaru's strongly familial designs: an outboard round projector, an inboard large bulb-type turn signal (here with a striated diffuser in front of the bulb) and a J-hook DRL, with side marker at the trailing outboard edge. There's a chipped-ice LED fog lamp in the bumper fascia.



The Ascent rear lamp is a pleasing new rendition of the Subaru design: a J-hook shaped dotty array for the stop/tail lamp, a block-shaped incandescent amber turn signal above an incandescent reversing lamp, and a red filler field inboard.  From lateral angles, the rear lamp is nicely integrated to the quarter panel by red-on-red styling.

The Crosstrek, too, has those same Subaru design elements: a J-hook DRL, an inboard bulb-type turn signal, a round projector (here ringed in blue) and an integral triangular side marker.

A twin-pocket reflector LED fog is down below.

The Crosstrek's tail lights have strong visual ties to those used on other Subaru models. They're made by Mobis, rather than one of the Japanese suppliers traditionally favoured by Japanese automakers.

The Forester's headlamp provides yet more evidence of Subaru's commitment to lighting as a key element of their visual brand identity.

There's a FORESTER callout in the bezel, above the side marker...


...and a stacked-shovels LED fog lamp in the bumper nacelle.

The Forester's new tail lights have an interesting variant on the C-theme. Turn signal is amber, but incandescent.


Base-model Imprezas still come with halogen reflector-type headlamps.

## Subaru, cont'd

They'll know the Outback is a Subaru, just by looking at the headlamp...

...but if they miss that, they'll know it by the rear lamp, too:

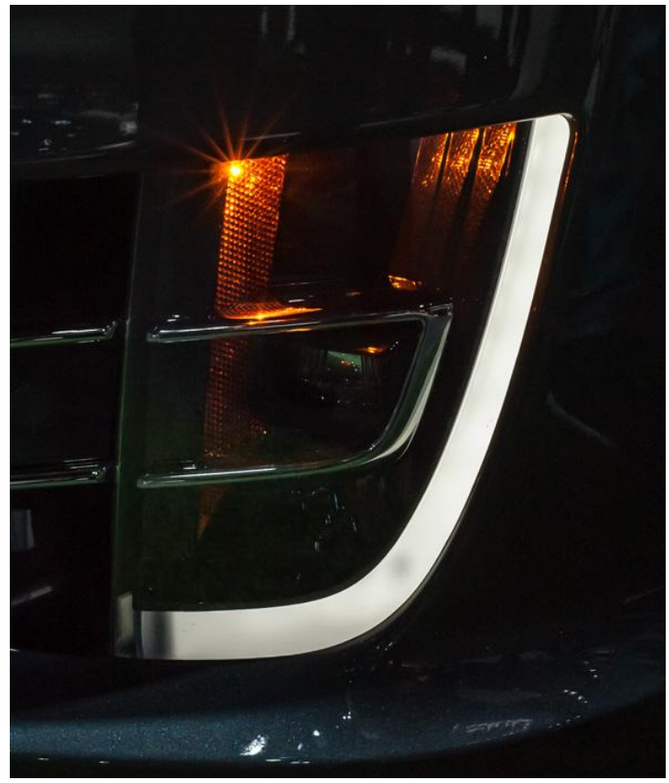

The fog lamp is still a halogen reflector.

## Tesla

The Tesla 3's headlamp contains a series of faceted shovel optics for the low and high beam headlights, capped by a milk-white DRL element. There's a wide, deep silver band at the leading edge.

The rear lamp reminds of the first-generation Model S lamp. The outer red band provide the tail light function, but only the very small innermost horizontal line lights up, in red, for the stop and turn signal functions. It is difficult to imagine how this could add up to 50 $cm^2$ of actual lit area.

The Tesla Model X DRL is an elegant J-shape defining the outer extent of the front face, down in the bumper fascia. It changes from white to amber to provide the turn signal function, while the side marker light and reflex hides in the inner wall.



The headlamp is a collection of slim reflectors with a boat-shaped milk-white front band.

The rear lamp has the familial Tesla design elements. The big red portion provides only the tail light function; the amber turn signal and red stop light are provided by the barely-there slim horizontal line at the bottom—here again, it's hard to count to 50 square centimetres.

## Toyota

The new Corolla hatchback has a triple-chamber front lamp. Each chamber is demarcated by a curved white line. The inner two chambers provide the turn signal, the outer contains the small round lens of the BiLED projector, and outermost is the integral side marker.

The tail light creates a depth effect with its mix of J-hooked light guide and reflector optics for the stop and turn signal functions, while the reversing lamp disappears to a blackout look when it's not in use. The stop, turn, and reversing functions are done with replaceable "LED bulb" light sources from Osram (white, amber) and Koito (red), and this rear lamp was also proudly shown at Osram's booth at CES.

The RAV4 has an innovative digital rearview mirror, sized and shaped like a regular one—even the anti-glare lever is present at the bottom—but instead of shiny glass, it's a display linked to the rear camera.

The headlamp has a trio of faceted shovel-shaped reflectors for the low and high beam. Turn signal is inboard and incandescent, while an arrowhead-shaped side marker is tucked outboard.

Red predominates in the RAV4 rear lamp, with a prominent red upper band providing stop and tail functions and wrapping forward to include the side marker. There's a very small triangular amber bulb-type turn signal (50 $cm^2$...? Where?) with its colourless lens continuing over onto the hatch and including the reversing lamp.

# CES

Here begins coverage of the Consumer Electronics Show, CES. It's held each January in the sprawling trade fair facilities of Las Vegas—though the exigencies of demonstrating such things as vehicle lights meant hoofing it out of town, beyond the reach of that city's intense lights of its own, as you'll read in following pages. CES organisers do a fine job segregating the various kinds of technology, so we were able to go directly to the vehicle-related tech and avoid being told we need a new whole-wall bendable 5G 9000P AI smart television set with blockchain.

Although terms like "personal transport" are burgeoning, with intent to include modes and methods not presently common, and it's evident the days are numbered of getting in a petrol-powered motorcar and controlling it with hands, feet, and brain, most of what's contemplated for the foreseeable future still involves recogniseably automotive technology and technique; unfortunately we aren't yet in the era of widely-available personal jetpacks or molecular transporters or flying cars that fold up into an attaché case, despite the perpetual promises of science fiction and the popular imagination. But we surely can't write imagination out of the picture—not by a long shot.

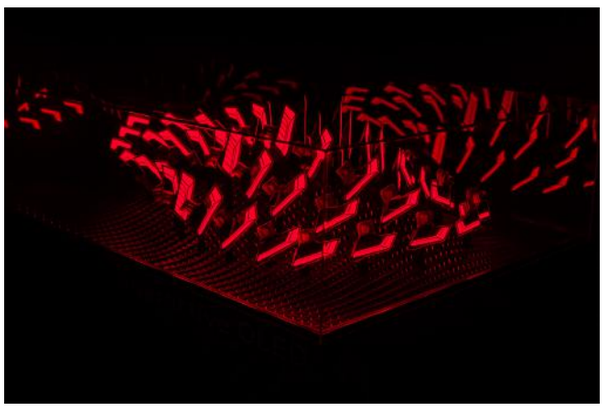
We also, by an equally long shot, can't possibly cover each and every bit of vehicle-vision technology at CES, or this report would run to reader-repellant length. Instead we cover some highlights and representative samples, supplemented by ongoing coverage in the weekly Driving Vision News.

Here we go, then—come see what we saw at CES!

## Audi

Renowned Audi wizard Stephan Berlitz came right out and said it: "We are using lighting to make digitalisation visible". Lighting, because of its centrally, deliberately visible profile on every vehicle, is an excellent area to get drivers, car buyers, and traffic participants familiar and comfortable with new, digitally-based ways of doing things. Berlitz demonstrated one example soon to go live from Audi: every car will be equipped with the same polyvalent hardware—advanced functions and features will be unlocked as "in-app purchases" via the car's touch screen or a smartphone app. Want the matrix-beam headlamps? The sequential turn signals and other fancy lighting functions? Any of numerous other tech? Instead of specifying them at the time of vehicle purchase or laboriously adding them by hardware retrofitment, you'll buy them by the day, month, year, or "forever". The implications: cars themselves might be priced such that buyers can avoid paying a luxury tax, then the goodies and features that would have raised the price above the tax threshold can be added in a few moments once the car belongs to the buyer. It will be possible to try out a set of features in the driver's own conditions to see if they find them worthwhile, or to activate features for unusual special needs. And when a car is traded in, the maker can zero out the add-ons and re-monetise them with the next owner.


More broadly, Audi built a lighting innovation darkroom called the Audi Light Lab, with a wide variety of show-and-tell. There were beautiful OLED sculptures, car lights projecting messages on the ground...and a miniature car with whole-body, interactive interface lighting. Light lines moved and shimmered to indicate that the car detected a nearby person. Animated light warned observers of an approaching emergency vehicle. The intent was on the one hand to demonstrate that intuitive vehicle-to-human communication requires more than just basic on/off, bright/dim, steady/flashing types of old signal modes, and on the other hand to show the state of the art in what's possible once those old constraints are laid aside. And look at the sideview cameras on the e-tron 55 Quattro!



## Ford

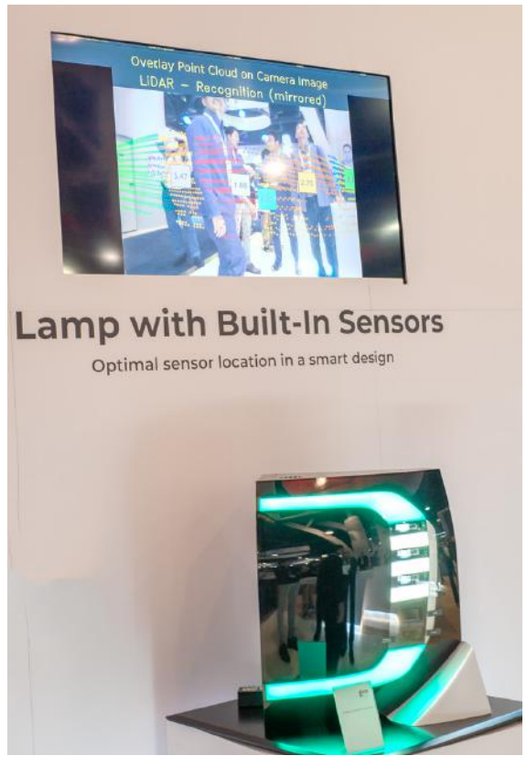
Ford's research van based on a Transit Connect van featured multiple rooftop spinning lidar units from Velodyne.

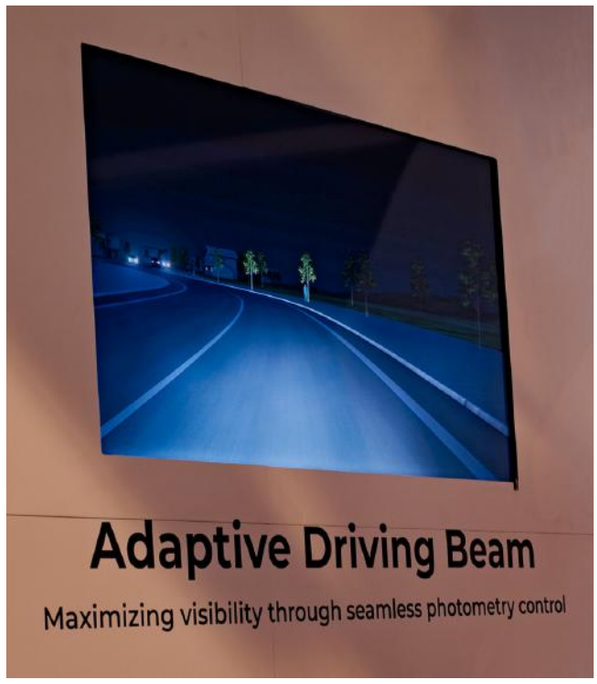


Ford's expo space was devoted to the automaker's vision of how traffic and transport will be reshaped in the cities of tomorrow. Specifics? Yes, lots: they showed off cellular V2X communications based on Qualcomm's 5G technology—Ford say they will equip vehicles starting in 2022. They also announced they'll be trialling their self-driving cars in Washington, DC soon.

## Koito

Koito's booth had wall-sized presentations on ADB and "communication lamps"—the new kinds of lamps that will eventually make their way onto autonomous cars. Prototypes were exhibited, including those with built-in sensors—fusion of machine-vision and human-vision hardware is clearly a hot topic. Hands-on hardware demonstrations allowed booth visitors to see how Koito's latest ADB lighting technology operates.




## LeddarTech

LeddarTech's airy outdoor space had vehicles equipped with a full complement of, as they put it, "AutonomouStuff".


That includes lidar solutions based on their solid-state NIR LeddarEngine with ranges exceeding 200 metres at 10% target reflectivity, as well as the new long-range Leddar M16-LSR, an off-the-shelf 16 segment solid-state LiDAR module for mobility applications. They also unveiled the LeddarCore LCA2 System-on-chip production samples. CEO Charles Boulanger calls his company's lidar development platform "truly a disruptive technology as it allows our customers to design and mass produce customised lidar solutions that meet the specific application requirements of OEMs, optimizing performance and costs for all levels of autonomy. This is a win-win model for all stakeholders, from the component supplier to the automaker, which explains its significant traction with multiple Tier-1 manufacturers already developing with the LCA2 LeddarEngine, as well as with our growing ecosystem".

# Magneti Marelli

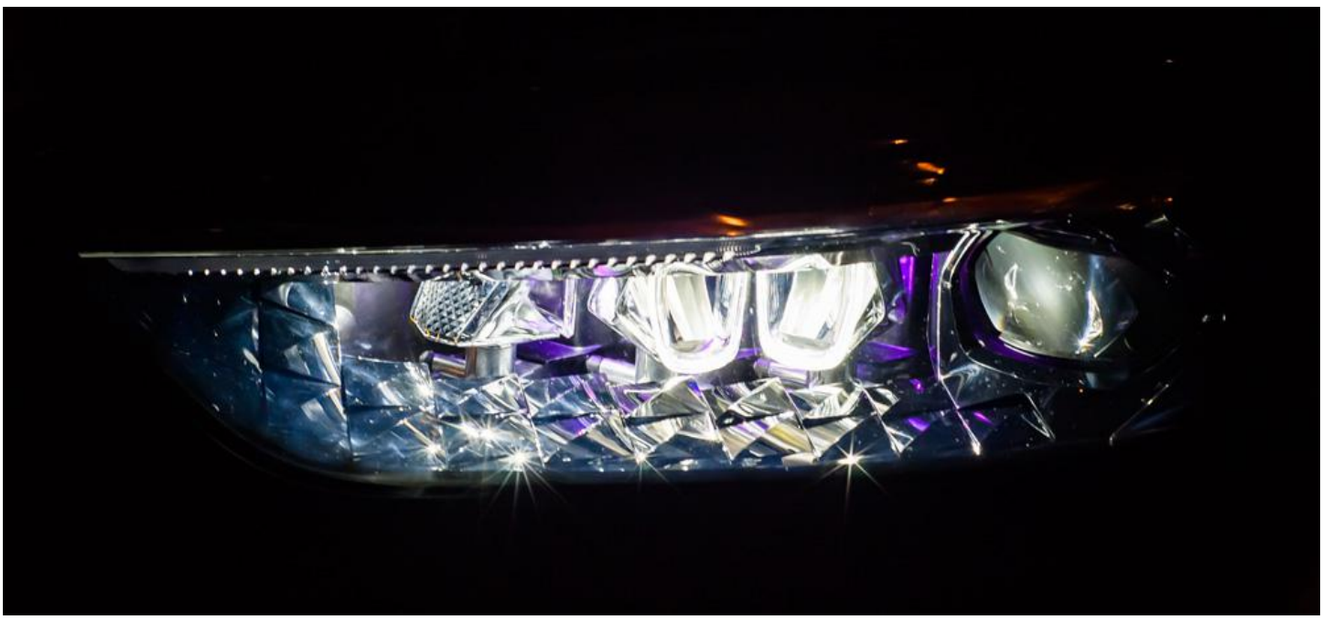

Magneti Marelli's show space was cram-packed with innovations big and small. Central to it all was the newest version of their Smart Corner system, integrating lights and multiple kinds of sensors and cameras for high functionality and efficient packaging while tastefully hiding components that would otherwise deface the car's surfaces and styling features. This year's Smart Corners add LiFi and an IR camera to the complement of sensors already including radar and lidar.

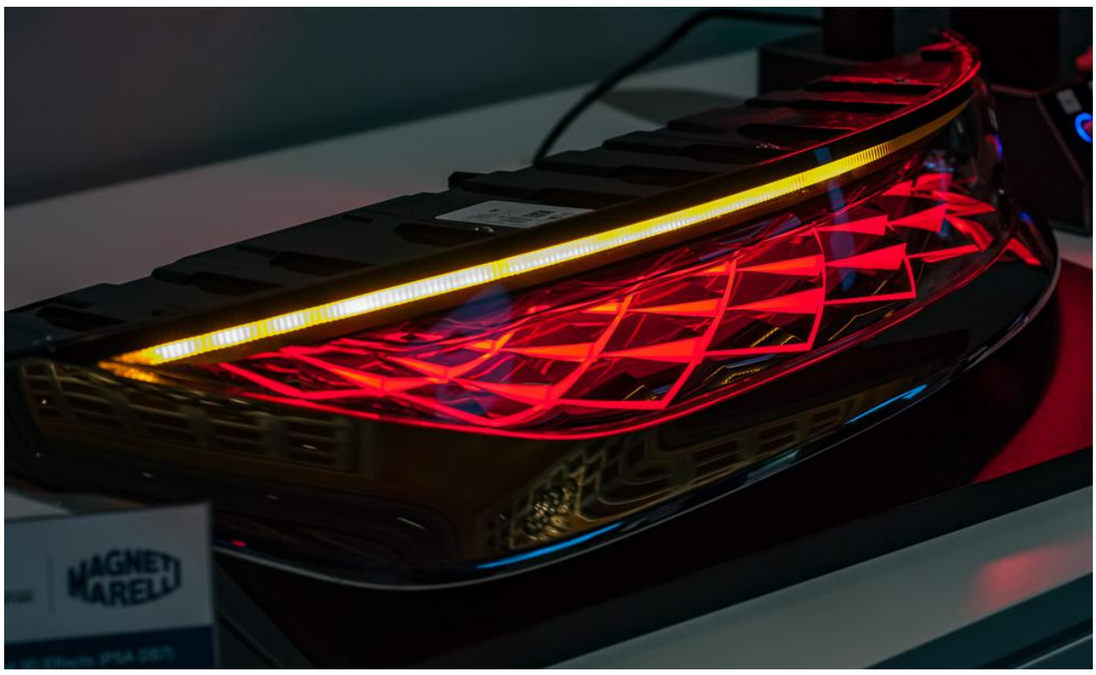
Marelli are hard at work on effective, efficient cleaners and heaters—obviously important when so many different kinds of electric eyes are depending on a clear view through the lens.

At the back of the Chrysler Pacifica demo vehicle, in addition to the Smart Corners, there was a bright, vivid, high-resolution display panel for messages and graphics. Also an interactive AI virtual assistant, whose face can be seen here.


## Magneti Marelli, cont'd

There were impressive lights on display, such as the beauteous headlamps (with their motorised internal elements) and taillamps (with their selectively-ablated metallisation) for the PSA DS7 regrettably unavailable in North America.






There was a taillamp prototype, fully and uniformly red when unlit, but which provides an amber turn signal function without a pink lens, a green filter, or any other cost-increasing, design-compromising elements:

## Magneti Marelli, cont'd

Marelli showed elegant new signal lights based on LED technology but looking for almost all the world like OLEDs: ultra-thin surfaces uniformly lit, with the added benefits of multiple colours from a single surface, full 3D sculpting capability, almost unlimited surface colour and decoration options, relative insensitivity to age, temperature, and other things deleterious to OLEDs, and—the biggie—much lower cost.

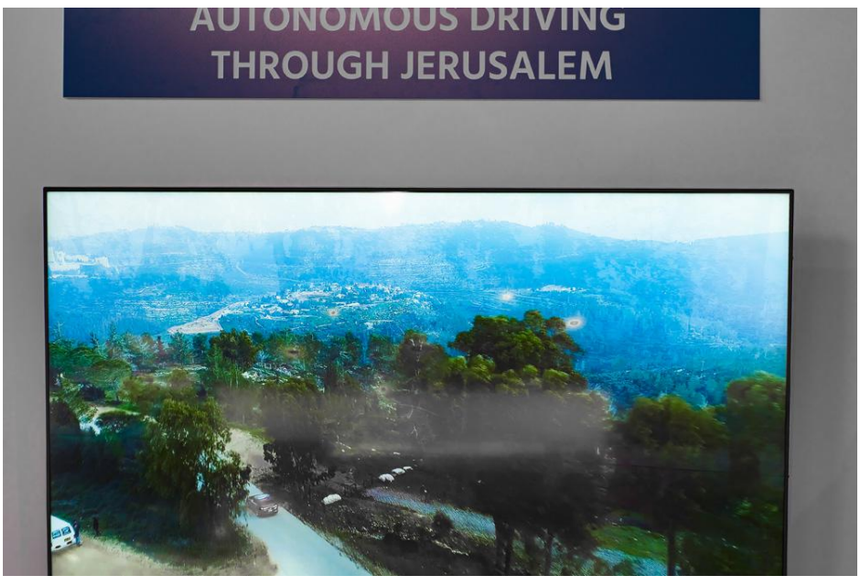
## Mercedes-Benz

Although terms like "personal transport" are burgeoning, with intent to include modes and methods not presently common, and it's evident the days are numbered of getting in a petrol-powered motorcar and controlling it with hands, feet, and brain, most of what's contemplated for the foreseeable future still involves recogniseably automotive technology and technique; unfortunately we aren't yet in the era of widely-available personal jetpacks or molecular transporters or flying cars that fold up into an attaché case, despite the perpetual promises of science fiction and the popular imagination. But we surely can't write imagination out of the picture—not by a long shot. Take a look at this Mercedes Vision Urbanetic, car of the future, bristling with technology and glittering with new kinds of lights and looking for all the world like it has enough personality to strike up a casual, purposeful conversation:

It's described variously as a "ride-hailing lounge", a "transport platform", or a "mobility concept". Transport as black box: you get in and it takes you where you're going, or it can be configured for shipping and delivery goods. We note that the blue-green lights on the Vision Urbanetic track with an aspect of ongoing research into what kinds of lights we can and should expect on tomorrow's AVs.

## Mobileye

The famed machine-vision maker from Israel showed off their product range. There was video footage of autonomous driving, and of a panel discussion on the subject, and Mobileye's Professor Amnon Shashua gave a **detailed lecture** on autonomous and assisted driving technology.


## Nissan

Nissan's IMx concept car sparkled and glittered not only with futuristic lights, but with a reimagined vehicle interior layout (prominently featuring advanced lighting) and overall body configuration.

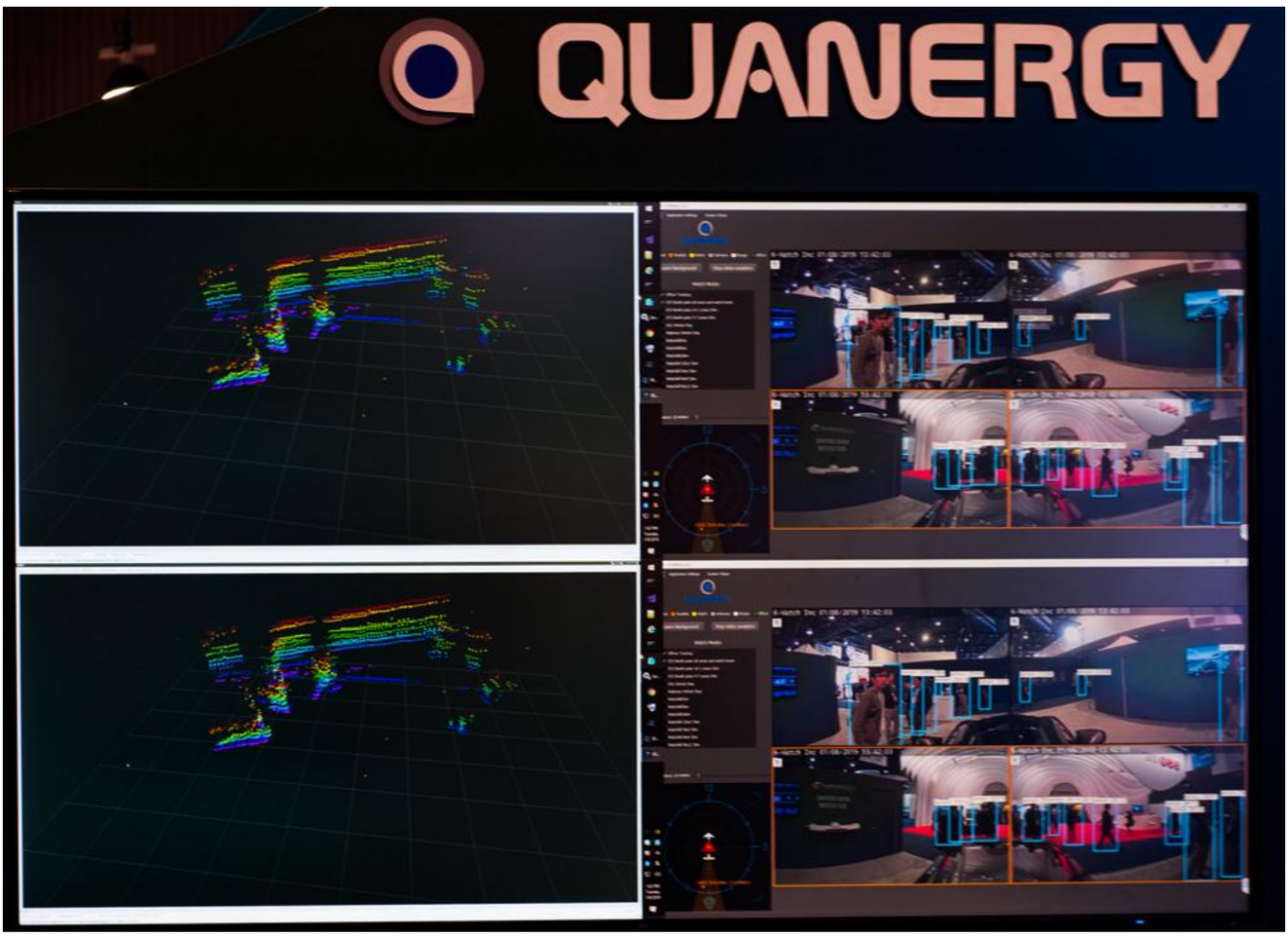
## Osram

Osram's booth proudly described the fruits of coöperative work with partners Innoviz (high-resolution 3D lidar sensors such as the InnovizOne solid-state lidar—a winner of the 2019 CES "Best of Innovation" award) and LeddarTech (LeddarCore SoC and LeddarSP platform) to devise automotive lidar products for ADAS and autonomous driving. Displays around the booth provided real-time sensing-and-tracking data and imagery of showgoers.

Osram showed the first series-production tail light using "LED bulb" light sources as standardised in UN Regulation 128. It's the lamp for the new Toyota Corolla Sport hatchback, made by Koito using Osram XLS white and yellow LED bulbs, and Koito's own red one.

## Quanergy

Quanergy had monitors set up showing their pedestrian-tracking capabilities, as applied right then and there to showgoers. Display items included their 6 WATCH VSP (Virtual Surveillance Partner), a security system that uses lidar and video technology along with data analytics to alert public safety officers to out-of-sight security threats and offers "force multiplier communication" to fellow first responders. The system, mounted on a 2019 Dodge Charger—a model popular with American police agencies—is powered by Quanergy's M8 and S3 lidar sensors.



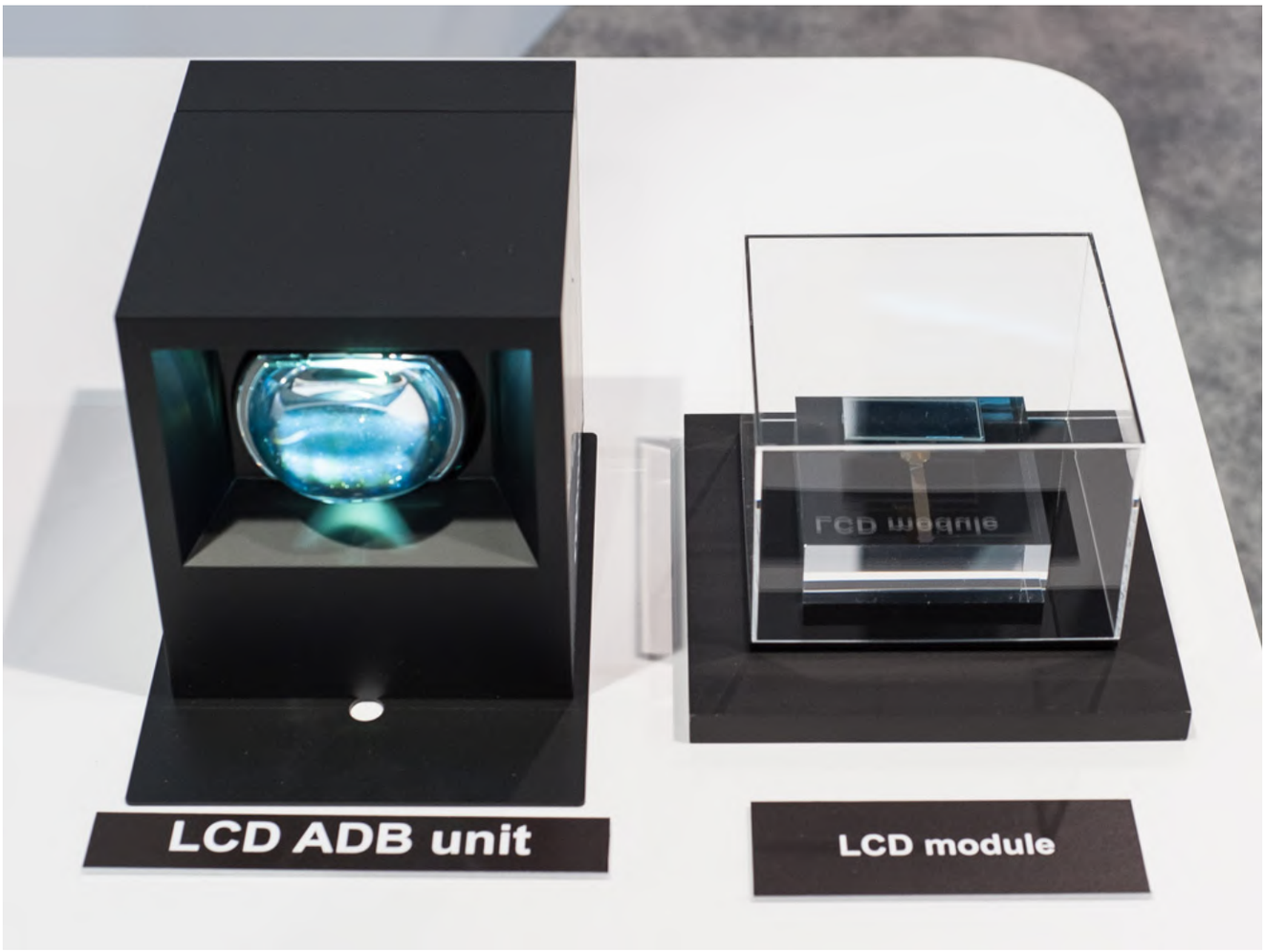
## SLD Laser

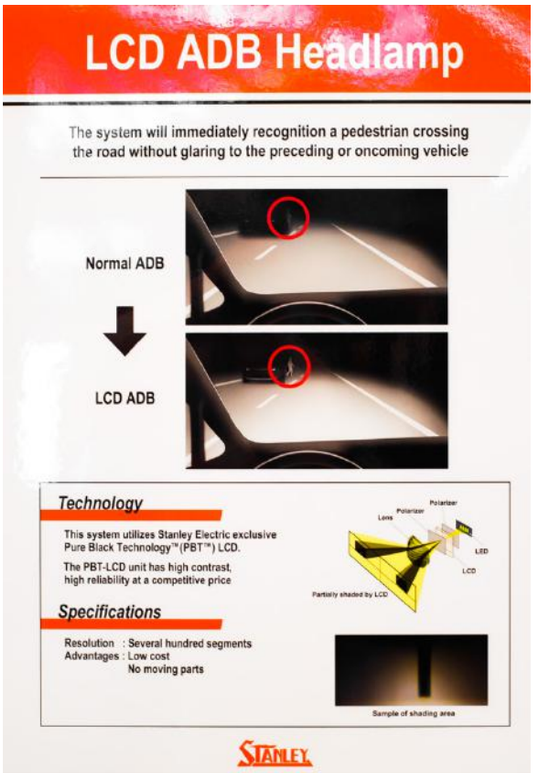
SLD Laser put on a night-drive event, and it was a real doozy: participants strapped into a custom-built truck equipped with auxiliary driving lamps based on SLD laser technology, then an experienced desert racer drove around in the dark of an off-road facility away from Las Vegas' city lights, demonstrating the laser driving lamps' utterly smashing light performance—almost a kilometre's beam reach from the compact light bar built by Baja Designs using SLD's laser light technology.

SLD also showed off their "world's smallest" headlamp concept, measuring just 1.5 centimetres high with low-beam and high-beam functionality, together with a 1.5 millimetre DRL. And they're working to incorporate MEMS technology for infinitely-shapable light beams to create advanced ADB. Another big potential: LiFi data communications – high speed, networked, wireless communications using light – which eclipse the capabilities of conventional WiFi communications with data transmission rates over 5 GB per second and extended range.

## Stanley

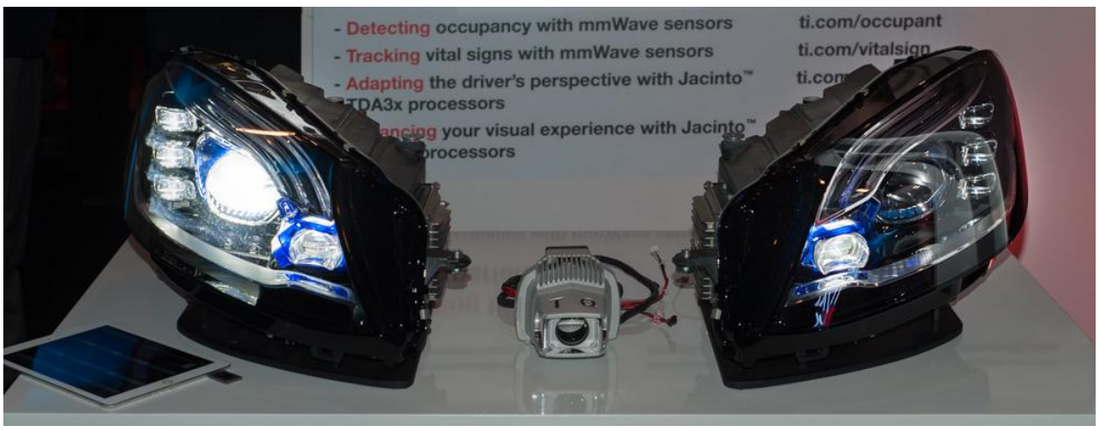
The portion of Stanley Electric's show space devoted to vehicle technology featured an LCD ADB headlamp module as well as a concept for 360° all-around-a-vehicle lighting and seeing and ToF (Time of flight) camera for autonomous cars.




## Texas Instruments

TI's big innovation in forward lighting is their 1.3-megapixel DLP module. at TI's booth it was embodied in Mercedes headlamps running through a variety of demonstration modes. That was the centrepiece of TI's




vehicular lighting exhibit, but by no means was it the only exciting thing. There were all kinds of other projectors, too, including one discreetly door-mounted that could project safety and advisory messages on the adjacent road surface—think of it: bicyclists could be warned of a car door about to open in their path, new kinds of "turn signal repeaters" could be projected for less likelihood of lane-conflict crashes, and numerous other use cases suggest themselves.



Moreover, there was a projector inside the car: a special UV-light projector pointed at one of the car's rear side windows, which in turn had a special UV-sensitive film on it. The film glows like a phosphor when struck by UV, but is otherwise transparent. Taxi and rentcar identification, easily changeable business messaging; here again, the use cases are many and varied.

TI also displayed a driver-supervision technology that acquires and tracks the driver's face to watch for appropriate attentional direction, fatigue, and other conditions. We also saw their "animating flexible LED" solution for vehicle signal lights.

# Valeo

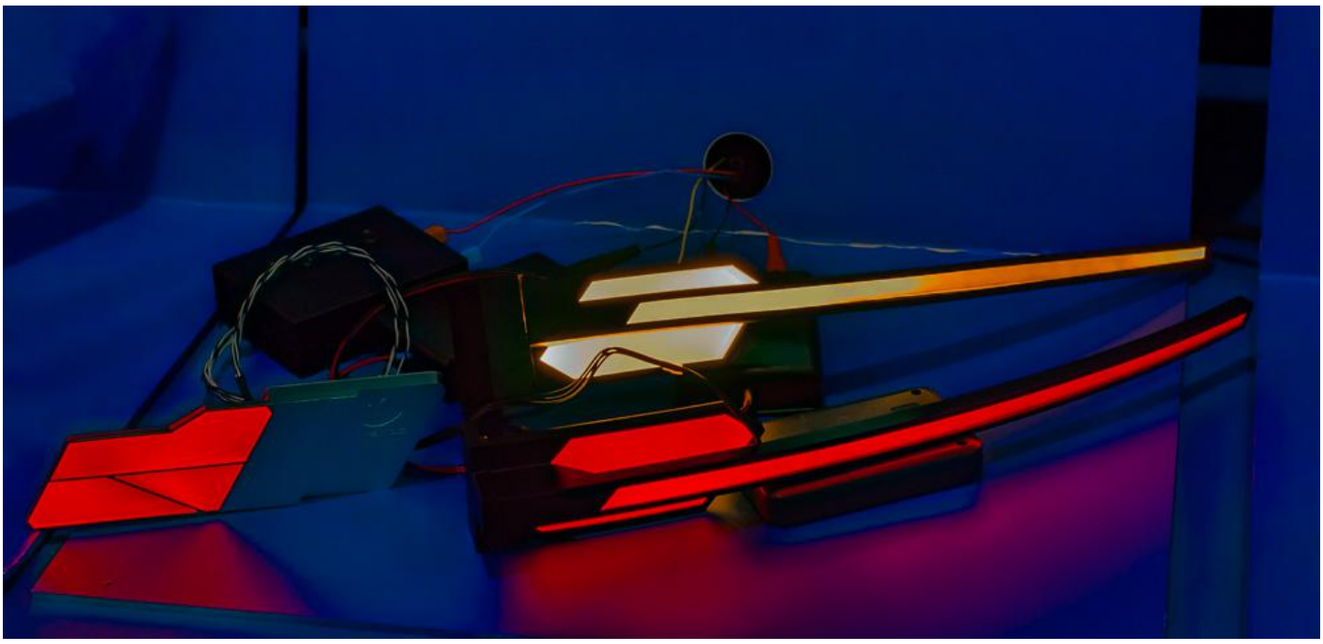
Valeo's big display space had a truck-and-trailer arrangement that looked pretty ordinary (aside from the bright green Valeo livery), but in fact is a giant advance in driver assistance: it's their Xtravue system, which gets a trailer out of the way of its driver's view by effectively disappearing it. That way, the driver can see the traffic, the road, and surroundings for much easier, safer manœuvring. The magic works by using video images captured from cameras located at the rear of both the tow vehicle and the trailer. It combines them into a single image the driver sees on a small screen. Everything happening behind the vehicle can clearly be seen, as the trailer itself effectively vanishes so the driver can negotiate traffic and manœuvre with ease, regardless of the trailer's size and bulk.



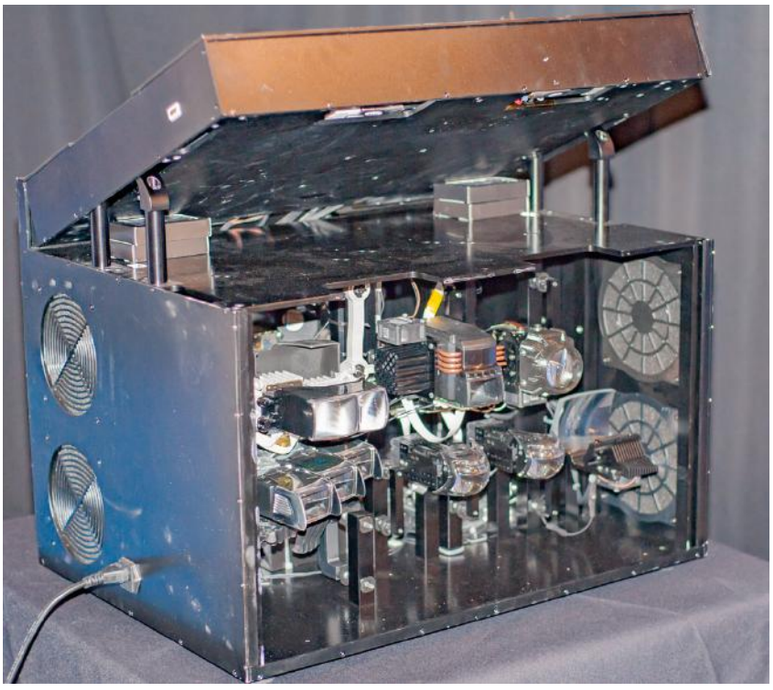
Also new: Valeo Voyage XR for virtual teleportation into a vehicle cabin. As shown in a **demonstration video**, the technology virtually transports a person inside a vehicle. This innovation has led Valeo to imagine the unique experience of teletransporting your loved ones on board.
Thanks to a wide range of technologies developed by the group—cameras, sensors, telematics, human-machine interface, and more—Voyage XR creates the illusion that a person of your choice, located outside the vehicle, is by your side. The individual's avatar appears in the rearview mirror and you can both interact using sound and image in real time. Meanwhile, the remote traveler enjoys an immersive experience thanks to a helmet and virtual reality controllers.

One of the key challenges in autonomous driving is safety. Valeo are aiming for their systems to achieve a safety level of less than one major incident per billion VKT (vehicle-kilometres travelled)—a higher level of safety than in the aeronautics industry. A big step toward that goal is Drive4U, Valeo's first autonomous car, performs all operations using only Valeo sensors that are already in series production—ultrasonics, cameras, lasers, radars and lidars—and artificial intelligence. Valeo say the vehicle is practically equipped with a fully-functional digital brain that can process the inputs and learn from the scenarios it encounters in the city. Related: Drive4U Remote, a system to operate autonomous vehicles remotely when assistance is required or, for example, medically necessary.

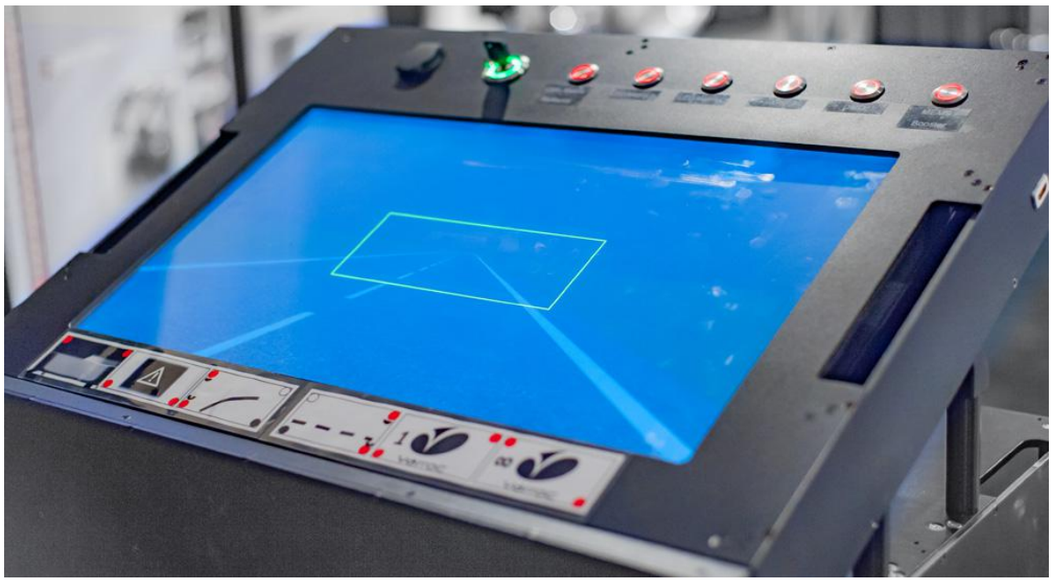
## Varroc



Varroc showed elegant new signal lights based on LED technology but looking for almost all the world like OLEDs: ultra-thin surfaces uniformly lit, with the added benefits of multiple colours from a single surface, full 3D sculpting capability, almost unlimited surface colour and decoration options, relative insensitivity to age, temperature, and other things deleterious to OLEDs, and—the biggie—much lower cost. Varroc call them "Surface LED". They also call it their "OLED killer", and it's difficult to imagine otherwise. Surface LED offers capabilities not achievable by OLEDs (true 3D, multiple colours from one emitting surface).



Like AL and TI, Varroc demonstrated high-resolution DLP headlamps. They were part of an intriguing show-and-tell box: numerous headlamps mounted in a highly portable case with a touchscreen controller. The case can be set up in an automaker's light tunnel—or anywhere dark, for that matter—and direct, back-to-back-to-back comparisons can be done across Varroc's whole portfolio of headlamp technology without the cumbersome need for multiple different vehicles.




Varroc's miniature car was back this year, significantly upgraded with bigger, brighter, higher-resolution message screens all around. The rear one is shown here, advising following drivers to stop for a crossing pedestrian.  And the side panels now display colourful icons to convey a wide range of messages.

## Velodyne


At Velodyne's booth, we saw products like their high-power, long-range Velarray, their VelaDome compact unit for high resolution short-range sensing with 180° × 180° FoV and the ability to detect objects as close as 0.1 m, and Velodyne's full range of lidar hardware—working in real time to show data collection and presentation as it might be used in assisted and autonomous driving. The chaotic, heavily-populated show floor served ably as a proxy for a busy city streetscape.

## VTTI

The Virginia Tech Transportation Institute were on hand to discuss the many kinds of experiments, research, and testing they do to bring new levels of safety and intelligence to the traffic system on an ongoing basis.

# List of DVN Gold Members

**28 Car Makers**

Aston Martin, UK
Audi, Germany
Bentley, UK
BMW, Germany
Changan Design Center, Italy
FCA, USA
Daimler, Germany
Ford, Germany
GM, USA
Great Wall, China
Harley-Davidson, USA
Honda, Japan, USA
Hyundai Motor, Korea, Europe
Jaguar-Land Rover, UK
Mahindra Mahindra, India
Nio, China
Nissan, Japan, Europe, USA
Opel, Germany
Porsche, Germany
PSA, France
Renault, France
SAIC TC, UK
Shanghai-Volkswagen, China
Seat, Spain
Skoda, Czech Republic
Toyota, Japan, Europe, USA
Volkswagen, Germany
Volvo Cars, Sweden

**19 Univ., labs, Consultants**

Darmstadt university, Germany
DEKRA laboratory, Nederland
FEP, Franhaufer, Germany
Fudan university, China
GranStudio, Italy
Hannover Leibniz Univ.(HOT), Germ.
Institut d'Optique Graduate School, Fr.
Karlsruhe Lighting Institute, Germany
LAB, France
Light Sight Safety, Belgium
Nuremberg university, Germany
Pacific Insight, USA
Parma university, Italy
Rensselaer university, USA
SLD Laser—formerly SoraaLaser
UMTRI, USA
University of California, Santa Barbara
YoungNam University, South Korea
Mr Shunxing Wang, China

**39 Set Makers and Tier 1s**

AL, Germany, USA
Denso, Japan
Elba, Romania
Farba, Turkey
FIEM Industries, India
Flex'N'gate, USA
Grakon, USA,
Grote, USA
Harbin Good Time, China
Hella, Germany
Hyundai IHL, Korea
Ichikoh, Japan
J.W. Speaker, USA
Koito, Japan, Europe
Lear, USA, Europe
Lite-On, Taiwan
Lumax, India
Magna, USA, Austria
Microlight Auto Parts, Taiwan
Mobis, Korea
NAL, USA
Neolite ZKW, India
Nordic Lights, Finland
Odelo, Germany
Olsa, Italy
Plastic Omnium, France
Peterson, USA
Rebo Lighting, China, Germany
Shanghai Koito, China
SL Corporation, Korea
Stanley, Japan
Truck-Lite, USA
Valeo, France, Spain, China
Varroc, Germany, Czech R.
Wipac, UK
Xingyu, China
ZF-TRW
ZKW, Austria
Zodiac, France

**65 Lighting Suppliers**

3M, USA
A2Mac1, France
AKKA, France, Germany
AML Systems, France
Anrui Opto, China
Aspöck Systems, Germany
ASYST Technologies, USA
Auer-Lighting, Germany
Bicomoptics, China
Bühler Alzenau, Germany
Covestro, US, China, Europe
Dajac, USA
DBM Reflex, Canada
Delvis, Germany
Diodes Dynamics, USA
Docter Optics, Germany
Dominant Opto Tech., Malaysia
EBW Electronics, USA
EcoGlass, Czech Republic
Elmos, Germany
Enmech-Mektec, Germany
Everlight Electronic, Taiwan, Germany
Excellence Opto Inc., USA, Taiwan
GXC Coatings, Germany
Holophane, France
IAV, Germany, USA
IMS, Netherland
Infineon, Germany
Instrument Systems, Germany
Jenoptik, Germany
Keboda, China
LG Innotek, South Korea
LG Electronics, South Korea
LMT, Germany, China
Lumileds, Nederlands
Maxell Joei Tech, Japan
Merck, Germany
Mentor Graphics, Europe, USA
Mitsubishi Electric, Germany, Japan
Myotek Industries, USA
Nalux, Japan
Nichia, Japan
NXP, UK
ON Semiconductor, Europe, Asia, USA
Optis, France
Optoflux, Germany
Osram, Germany
Oxyphen, Switzerland
Panasonic, Japan
Proper Group, USA
Red Spot, USA
Sabic, USA
Samsung Electronics, Korea
Sapphire, USA
Sea Link International, USA
Segula Technologies, France, Austria
Seoul Semiconductor, Korea
Soraa Laser Diode, USA
Synopsys, USA, Germany
Texas Instruments, USA
TQ Technology, Taiwan
Vosla, Germany
Weidplas CH, Switzerland
WL Gore, USA
Zollner, Germany