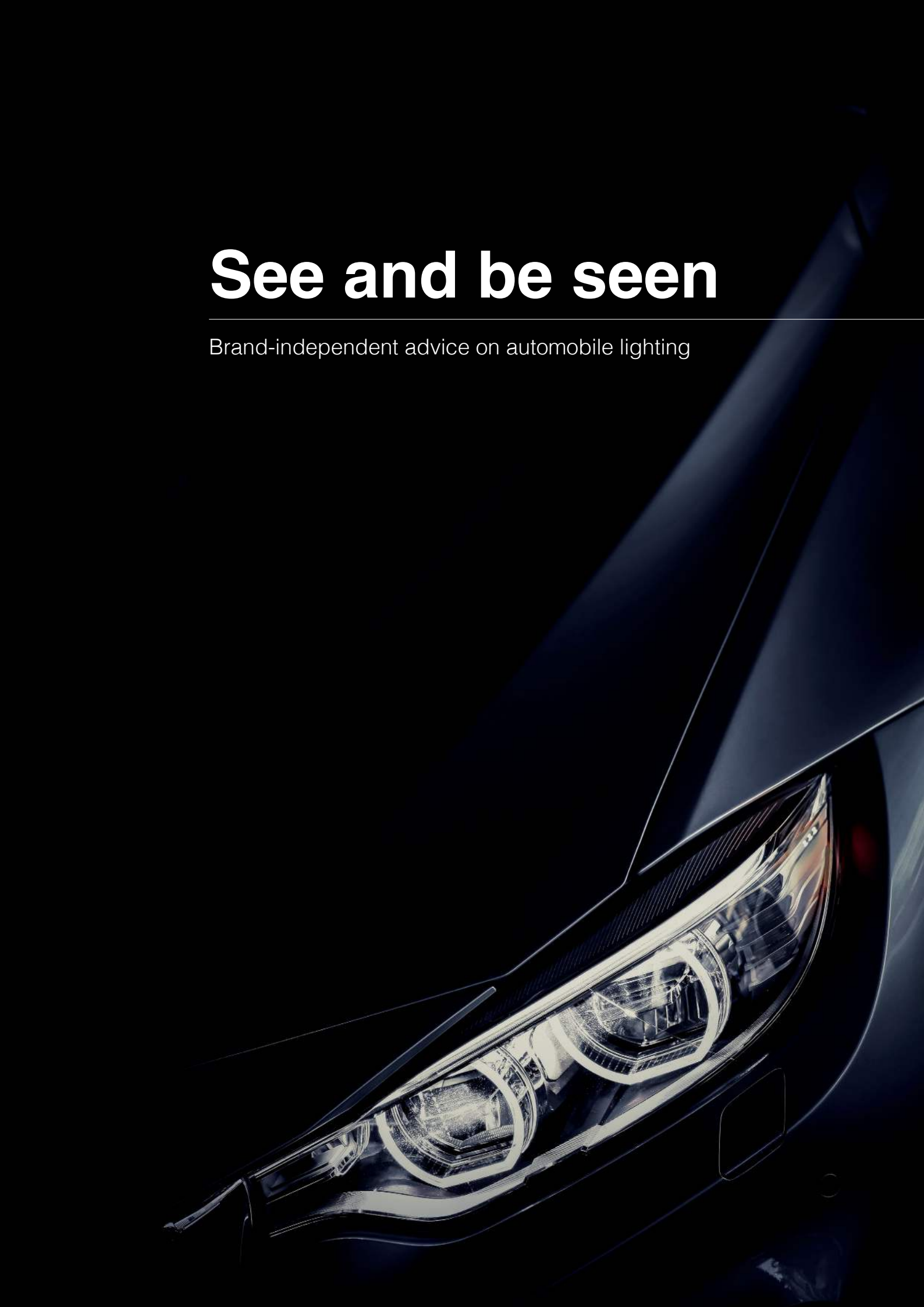
See and be seen

Brand-independent advice on automobile lighting



Now you see me; now you...

You are about three times as likely to have a serious traffic accident when driving at night as opposed to during the day. In spite of nighttime travels accounting for just 25% of all traffic, the US National Highway Traffic Safety Administration reports that almost every second fatality occurs in dark conditions. So ensuring good light output isn't only about looks and an enjoyable driving experience – it could literally save lives. What is more, even if you have a brand new high-end vehicle with the latest LED technology, your headlights will need maintenance in order to stay safe. And there are pitfalls; without being properly informed, you could waste a whole lot of money on so-called upgrades without seeing much difference. In fact, you might even end up with a downright dangerous setup.

These are the things every driver should know.

Yesteryear: *fluted glass lenses*

Modern times: *polycarbonate plastic lenses*

The basics of automotive lighting

Before we get into recommendations of particular upgrades, let's cover some basics that you need to be aware of to make an educated decision. There are three main elements to consider: headlight lenses, reflectors/projectors and bulbs. (We'll cover parking lights and turn signals without further ado later in the piece.)

Headlight lenses

Pretty much every vehicle manufactured after the year 2000 rolled out of the factory with headlight lenses made from polycarbonate plastics. These are great in that they are lightweight and enable beautiful, clear designs. But they have a major drawback compared to the fluted glass lenses of yesteryear; over time, the plastic grows opaque from exposure to sunlight and road debris. This obviously decreases the light output of whatever fantastic technology that you may put behind the lens.

Reflectors and projectors

Let's start by clearing up some common confusion about what constitutes a reflector versus a projector.

A reflector sits behind the bulb or diode (LED), reflecting the light forward (in old-style headlights, there's also a tiny reflector directly in front of the bulb, which prevents light from blinding oncoming traffic, instead sending it backward, into the main reflector). Most halogen headlights rely wholly on reflectors to both reflect and steer the direction of the light. Such headlights are referred to as "reflector headlights".

Reflector halogen headlight

A projector is a lens through which the light passes. It provides exact steering of the light, projecting a sharply defined beam onto the road. Any headlight that contains such a lens is referred to as a "projector headlight" (please note that the term "headlight lens" used elsewhere simply refers to the polycarbonate cover of the headlight itself, which should have as little impact on the light as possible; it's only there to provide weatherproofing).

Xenon headlight assembly:
A reflector bowl reflects light through a projector lens.

However, as you can see, any projector headlight is strictly speaking also a reflector headlight, as it relies on a reflector to send the maximum amount of light through the projector lens. And, to make matters worse, the reflector in a “projector headlight” is often not referred to as a reflector at all, but is instead described as a “projector bowl”.

Not surprising, then, that so many people are confused by the market terminology.

Anyway, call them what you may: both reflector and projector headlights are precisely engineered works of art. That unfortunately doesn’t mean that you can count on your brand new car to come with very good reflectors or projectors. For one thing, car manufacturers tend to rely on technology that was around when they first started developing designs for the vehicle – years before it went into production. Secondly, in order to keep costs down, they use generic headlights from suppliers such as Hella and Valeo, which often feature outdated designs. These will pass the test of road safety in terms of light pattern when new, but output is often relatively poor, and the reflective layers on many of these units will peel away over time, sometimes to the point where they become black inside. Not a recipe for optimal brightness.

As with headlight lenses, you want to ensure that your reflector or projector is in perfect working order, or any money spent on powerful bulbs will be wasted.

Bulbs

There are three options: halogen, xenon/HID or LED, each with their own set of characteristics. Here are the main points to keep in mind.

Halogen

- Poor brightness
- Will provide consistent light output throughout working life
- Estimated lifetime: 200-400 hours
- Achieve maximum brightness immediately
- High energy consumption

Xenon/HID

- Up to 600% brighter than halogen bulbs
- Lose up to 70% of maximum brightness over working life
- Estimated lifetime: 2,500 hours
- Require warm-up time before achieving full brightness
- Medium energy consumption

LED

- Generally almost as bright as xenon/HID bulbs
- Maintain maximum brightness throughout working life
- Estimated lifetime: 5,000 hours
- Built into the projector; cannot be removed
- Achieve maximum brightness instantly
- Low energy consumption

Purpose-built bi-xenon retrofit: staying sharp

Plug-and-play xenon bulb: all over the shop

Importantly, it should be noted that the light pattern and efficiency of the bulb is dependent on the reflector/projector, which has been carefully engineered to fit a particular type of bulb. This design is very, very precise to account for the huge magnification that occurs between the tiny light source and the wide beam. Put a plug-and-play LED or a xenon/HID bulb into a halogen housing, and the light pattern will be distorted. Don't believe crafty bulb sellers who try to convince you otherwise. We've tested dozens of plug-and-play conversions – each time with the same result: the light pattern becomes dangerously distorted, potentially blinding oncoming traffic. This is why you should never install xenon/HID or LED low-beam bulbs in housings that weren't specifically designed for such bulbs.

Plug-and-play conversions are acceptable only for your high-beam lights, which will never be used with oncoming traffic. Whilst they will still result in a distorted light pattern and the output is less than optimal, at least they won't create a road hazard.

So much for the background on lighting technology. Let's get to the fun stuff. *Retrofitting.*

Headlight upgrades

You guessed it; this is before…

...and this is after polishing

Restoring the headlight lenses

Ok, so this isn't really a fun upgrade. Strictly speaking, it isn't an upgrade at all, but a quick and cheap fix that, if necessary, you should get sorted before you do anything else. Should your lenses have gone all cloudy from exposure to sun and chemicals, you can sand and polish them back to perfection. You can do this yourself or drop the car off with a detailer. Just make sure to have a layer of UV-protective coating applied once the polishing is done, or else your polish won't last for very long.

When to do:	*Your headlight lenses are no longer clear*
Cost:	*€50-75*
Improvement in performance:	*10-50%*

NOW for the fun upgrades!

Bi-LED projectors

There's little doubt that LED is the future standard in automotive lighting (and, by the way; whenever we say "bi-", that means low as well as high beam). Light output is on a par or greater than that of xenon; LED lights retain maximum brightness throughout their lifespan (xenon lights do not); they consume considerably less energy than halogen or xenon; they do not require any ballasts; and the versatile LED technology lends itself to creative and beautiful designs for a multitude of uses.

However, as LED technology is relatively new, it's also relatively undeveloped and expensive. If you already have bi-xenon projectors, it might not be worth it for you. For upgrades from halogen headlights, it's well worth considering, though. If your current headlight has a separate high-beam reflector – most halogen headlights do – it will remain in place when you install the bi-LED setup, which is fitted where your old low-beam reflector used to sit. You will in other words have a bonus high beam, and since it won't ever blind oncoming traffic, you can fit this with a plug-and-play LED or xenon bulb for yet more light. Count on a super-powerful high beam!

Halogen vs. LED: like night…

...and day

LED setups currently outperform xenon kits in a single main regard only: they retain their maximum brightness throughout their lifespan. They also don't need any ballast to power the light, merely a tiny driver that usually can be mounted inside the headlight, and they consume less energy than xenon bulbs.

On the downside, LEDs are susceptible to overheating, which leads to lower light output and lifespan of the bulbs (diodes, really). LEDs therefore come with advanced cooling systems such as fins and fans, making for bulkier kits that many headlights simply don't have room for. Before you make up your mind on what option to go for, you'll want to check whether your vehicle is at all compatible with LED retrofitting kits. Simply enter your vehicle details into the search wizard at www.retrofitlab.com and you will know in no time.

Barring any overheating issues, LEDs should outlast xenon bulbs. When they do expire, you'll have to swap the entire assembly, though, because the LED is built into the projector.

When to do:	*You have halogen headlights or simply want the latest technology with maximum light output and instant full brightness (also, you've checked that your headlight will actually accommodate the relatively large LED kit)*
Cost:	*€250-300*
Improvement in performance:	*50-600% compared to halogen headlights*

New bi-xenon projectors

There's a reason we put "new" in the subheading for this one, because as you've already learned, many OEM bi-xenon projectors are just no good to start with. Light output is lower than it should be even in the showroom, and after only a few years, the reflective layers have peeled off and – voila! – you suddenly have black headlights.

It might take a while for you to discover the gradual decline in light output, but when you do, your first reaction might be to simply buy new bulbs. But since your projectors are degraded, that won't do much good. So you'll then be inclined to ask your dealer for new reflectors. Alas, they can't sell you any; they can only offer complete headlights – with a little price tag dangling off them reading, "€1,000" (or more). Luckily, for most headlights, there are projector retrofit kits available for a fraction of that price. To find out whether there is one for you, simply visit www.retrofitlab.com and enter your vehicle details into the handy search wizard.

Of course, if you currently have halogen headlights, upgrading to bi-xenon projectors should be a priority regardless of your reflectors or projectors. Bi-xenon setups can give you the same boost in light power over halogens as LEDs: 50-600%!

The only major downside with bi-xenon is that the bulbs will gradually lose up to 70% of the maximum brightness over their working life. For a minority of headlights, there's one additional minor downside; if you have your low beam turned off during the day and want to signal by flashing your high beams, the light emitted will be quite weak, because the xenon bulbs need time to warm up before achieving maximum brightness. But this is hardly a safety concern, and it only applies to a select few headlights when the low beam is turned off in the daytime.

Additional benefits over halogen bulbs include lower power consumption – 35W instead of 55W – as well as significantly longer lifespan; xenon bulbs last for around 2,500 hours compared to the 200-400 hours of halogens. To put that into perspective: if you drive 20,000km per year, you can probably get 8-10 years out of your xenon bulbs – although, with the gradually decline in brightness, it's recommended that you replace them after 4-5 years. Compared to the max life you'll get out of halogens under the same circumstances – about 1.5-2 years – that's a long time either way.

Similar to LEDs, bi-xenon retrofit kits lend your car an entirely new look, and you can choose from a range of different colour temperatures. They also leave any separate high-beam reflector in place, giving you a bonus high beam that you can power with a plug-and-play xenon bulb or LED for additional light (in the latter case negating the issue of warm-up time for daytime flashing of high beams as described above).

A final point to mention is that xenon light bulbs require ballasts to be mounted outside the headlight assembly, in the motor compartment. This makes for a somewhat time-consuming job, but it's well worth it. When all is said and done, we're sure you'll agree that it was a truly bright idea.

When to do:	*You have halogen headlights or xenon projectors that provide poor light output due to outdated designs or peeling reflective layers, and you want maximum light without paying an arm and a leg*
Cost:	*€200-300 for a full kit, including xenon bulbs (and you can get an even cheaper deal if you just happen to own some less-than-desirable plug-and-play xenon bulbs, whose ballasts you can transfer to your new, dedicated retrofit)*
Improvement in performance:	*50-600% compared to halogen headlights*

Upgraded halogen bulbs

Noting that halogen bulbs will never get anywhere near the performance of a good xenon or LED setup, simply buying new and improved halogen bulbs is a super-quick and cheap option. Yes, there are crazy claims of certain halogen bulbs providing twice the light output of others and, no, they won't, but there are bulbs that will give you noticeably brighter light. The downside? They don't last as long as regular halogen bulbs. And since the lifespan of halogens is short as it is, you might find yourself having more light bulb moments than you bargained for. Still, a quick and cheap way to brighten your day. Temporarily.

When to do:	*You want an immediate upgrade in light output without spending time or money on a retrofit*
Cost:	*€25-35*
Improvement in performance:	*10-20% (hooray!)*

Plug-and-play xenon bulbs and LED

For aforementioned reasons, you should never use plug-and-play bulbs or LEDs for your low beam assembly – it will make for a dangerous light pattern that could blind oncoming traffic (nag, nag; you've heard this before). However, if you don't mind the distorted light pattern and the fact that output from this particular bulb won't be optimal, you can easily swap the bulb in any separate high-beam reflector for a xenon bulb or LED. This won't do a thing for your low-beam light, of course, but will provide a powerful high beam – even if it goes off in every direction (our apologies to any deer in the headlights).

When to do:	*You want a quick and cheap yet powerful upgrade of your high beam*
Cost:	*Plug-and-play xenon around €50; LED €50*
Improvement in performance:	*50-200% compared to halogen*

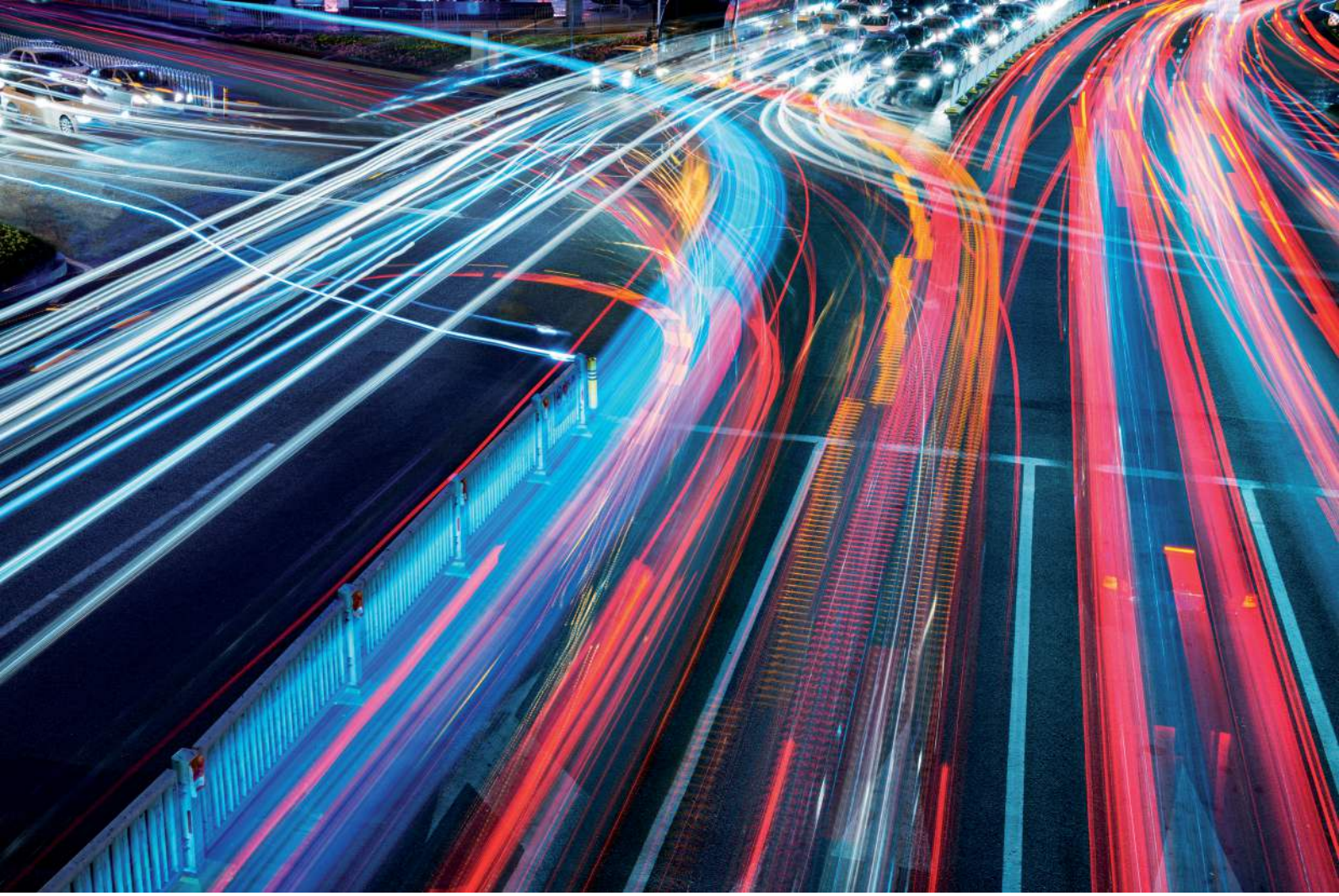
Finishing touches

Right, so you have upgraded your halogen to an all-enlightened xenon or LED setup. Or maybe you've just bought a new halogen bulb or two… or three.

Ok, let's drop that subject.

To finish off your upgrade, you may want to have a look at your parking light and turn signal bulbs. Swapping them for LEDs is quick and easy; in the worst-case scenario you will just have to install a little resistor in the wiring to prevent any super-fast flashing. You'll have lights that go on and off instantly; they will provide more light; they will last much, much longer; and they will draw less power. What's more, they will match the colour of those brand new xenon or LED headlights that you just had installed.

When to do:	*You have installed new xenon or LED headlights and want matching parking and turn signals/you would simply like for your fellow drivers to discover those things called indicators*
Cost:	*€12.50-50.00*
Improvement in performance:	*10-30% brighter light; 80% less power usage*



Summary: a brighter future is within reach

Walking into a car dealership might give you the idea that installing new headlights will be prohibitively expensive and that only so-called “original parts” will do. The truth, however, is quite the opposite; even luxury vehicles are commonly delivered with outdated headlight designs that feature a low degree of efficiency even when new and quickly deteriorate – often to a point where the headlight is black inside. A dedicated xenon or LED retrofit, by contrast, is modern, affordable, efficient and durable; one of the best investments you can make in order to avoid becoming a statistic.

To see what retrofit technology is available for your particular vehicle, simply visit www.retrofitlab.com and enter your make and model into the intuitive search wizard. You can then immediately see just how little will be required to take your vehicle to the next level.

RETROFITLAB.COM
IMPROVED VEHICLE LIGHTING SYSTEMS

www.retrofitlab.com