

Research Report
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The global automotive exterior LED market

Including detailed market fitment, volume and value estimates and forecasts of all exterior LED lighting applications in Western Europe, Japan and North America through 2012

by Matthew Beecham



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Chapter 1 Introduction

LEDs shift from indication to illumination

LEDs are the technology of the future for automotive lighting

Renault says that with their small size, powerful light emission, extreme reliability, low energy requirement and long lifespan, LEDs are 'the technology of the future for automotive lighting.' In fact, Lumileds (a joint-venture between Agilent Technologies and Philips Lighting) believes that the incandescent bulb is 'headed for extinction in rear vehicle lighting' as LEDs become bright enough to replace conventional bulbs on a one-for-one basis.

Historically, the use of LEDs, though widely seen for years in a number of non-automotive applications, has been limited to centre high-mounted stop lamps (CHMSLs) and traditional brake lighting and side-panel markers. It is now ready for use in headlamps. In the US, headlamps with LEDs for main lighting functions are already permissible according to the applicable SAE standards. In Europe, at least within the jurisdiction of ECE¹ regulations (which covers Europe and Asia), an approval is expected by 2008. Signal functions in the headlamp (indicator, position and daytime running light) with LEDs are already approved both in the ECE and SAE² jurisdictional areas.

LEDs are an environmentally friendly, high-efficiency source

An LED is a compact, solid-state semiconductor device that converts electrical energy into light. Compared to traditional incandescent lamps with equivalent output, LEDs demonstrate a number of benefits. LEDs use less power, are smaller and last longer. Depending on configuration, LED-based front lighting sources require up to 40% less power than traditional lighting sources. This allows OEMs to apply the saved energy to other comfort or safety features. Unlike HID/Xenon, LEDs are a mercury-free technology, making them an environmentally friendly, high-efficiency source. In addition, an LED has a source life of over 10,000 hours, meaning the headlamps can outlive the life of the vehicle. There is also a safety element: LEDs can illuminate a split second faster than conventional incandescent lamps, thereby improving driver response and providing extra braking distance of five metres at 75mph. The compact size of LEDs also contributes to greater design freedom, allowing for the integration of lighting functions into the overall front-end design.

LEDs still cost more than incandescent bulbs

However, LEDs still cost more than incandescent bulbs, thereby limiting their growth into other applications. For this reason, LEDs have increasingly been used in rear lighting applications. In a recent interview with ABOUT Automotive, Drake Stalions, Manager, Sales (Automotive), Nichia America Corp explained that: *"The real challenge is that even though LEDs are more efficient than traditional light sources and transfer more of that energy into light than heat, they can still be easily damaged by heat; not only the ambient heat but the heat generated within the LED itself."*

¹ ECE ~ Economic Commission for Europe.

² Society of Automotive Engineers.

A whole new level of expertise and analysis is required

And in response to the question of how that might be overcome, he continued; *“An LED power package is only as strong as the LED power system that it goes into. If you design an LED power package with good thermal attributes and then put it on a regular circuit board, it will almost certainly underperform. It needs a systems approach. A lot of headlamp and tail lamp manufacturers are used to just plugging in a bulb. But now they are really having to understand the technology and how to design a system around the LEDs. It is a whole new level of expertise and analysis that is required.”*

Report coverage

In this first edition reviewing the key market drivers for LED automotive applications, **Chapter two** sets out our market fitment, volume and value forecast for exterior lighting through 2012.

Although we see a strong European automotive LED interior market, our forecasts are based solely on exterior automotive LED applications.

Furthermore, our forecast fitment trends for LEDs are not extrapolative – based simply on trends – but dependent on the underlying drivers of supply and demand. Our estimates are supported by interviews with experts at LED manufacturers and OEMs across Europe, North America and Japan.

Chapter three reviews the technical advances in vehicle LED lighting. The most promising advance is LED headlamps, expected to appear in 2008. Industry observers say LEDs will rank between halogen and xenon discharge lamps in terms of their efficiency. In addition, LED headlamps can be up to 55% thinner than their halogen/xenon counterparts, thus opening up space in the engine compartment or grille to add further styling options.

Chapter four profiles just a few of the main players in the LED market, namely Agilent Technologies, Hella, Lumileds, Nichia and Osram Opto Semiconductors.

Figure 2: Visteon's LED front lighting concept

Source: Visteon.

Visteon is currently working with a number of OEMs in development projects involving LED front lighting

Visteon believes that while other lighting systems offer a degree of styling flexibility, LED front lighting systems may revolutionise the way designers think about front headlamp design. Arrayed LEDs not only look unique, their flexibility may eventually help designers 'break out of the box' of the traditional, two-headlamp front-end design approach. For example, since LED front lamps do not require a single packaging unit – or 'capsule' – designers could potentially submerge the lights into the grille design so that no lighting source is recognisable during daylight hours.

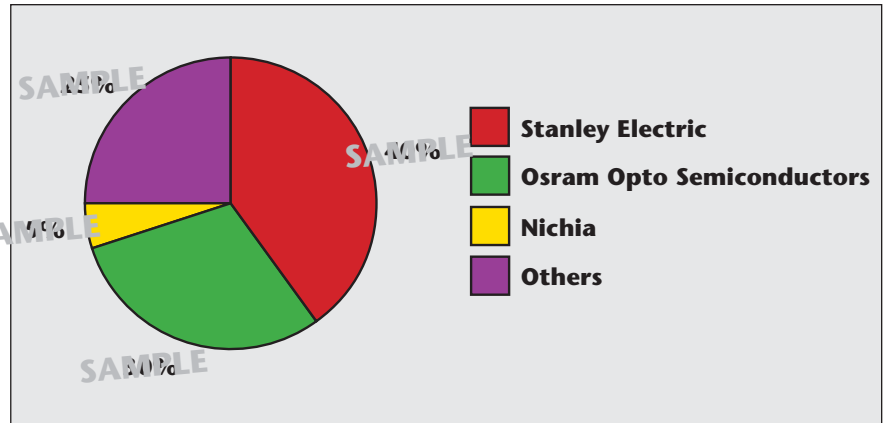
Unlike HID/xenon lamps, LED-based front lamps are recognisable not only in night mode but in daytime as well. Because they are much thinner than traditional headlamp packages, designers have significantly more flexibility to design increasingly dramatic overall front-end styling. *"Visteon has unique in-house electronics capabilities and engineering expertise that make us think LED is more than a viable future front-end light source,"* said Dieter Schaper, Visteon's Global Director, Exterior product line team. *"LED technology is not only a great way to help you see, it's a great way to be seen."*

Visteon is currently working with a number of OEMs in development projects involving LED front lighting and anticipates the first production installation of LED headlamps by 2008.

Market shares

As far as the low brightness (InGaN) LED market is concerned, we estimate that Stanley Electric and Osram Opto Semiconductors dominate the global automotive market. Nichia is also starting to enter this market.

Figure 3: Low brightness LED global market for automotive applications, 2004 (% of value)

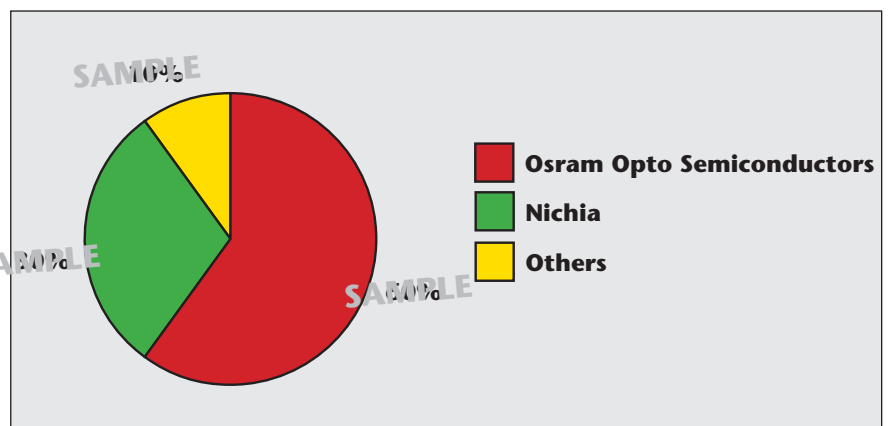


	%
Stanley Electric	40
Osram Opto Semiconductors	30
Nichia	10
Others	20
Total	100

Source: Auto Research Analysts and ABOUT Automotive.

For high brightness LEDs, Osram Opto Semiconductors has around 60% of the global market followed by Nichia with about 30%.

Figure 4: High brightness LED global market for automotive applications, 2004 (% of value)



	%
Osram Opto Semiconductors	60
Nichia	30
Others	10
Total	100

Source: Auto Research Analysts and ABOUT Automotive.

Overall, Nichia enjoys approximately 25% of the total LED lamp market (for all applications), head and shoulders above its nearest competitor Osram with 7%, followed by Citizen Electronics, Agilent and Toyoda Gosei each

Table 4: LED rear combination lamp¹ fitment volumes for passenger cars and light trucks, Western Europe, Japan and North America, 2003 - 2012 ('000 units)

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Western Europe	145.4	148.5	142.4	127.7	113.1	100.0	88.0	77.0	67.0	1,782.0
Japan	171.0	171.9	171.7	172.0	172.0	172.0	172.0	172.0	172.0	504.0
North America	962.5	1,172.6	1,200.2	1,200.2	1,200.2	1,200.2	1,200.2	1,200.2	1,200.2	3,604.0
Total	1,278.9	1,493.0	1,414.3	1,513.9	1,485.3	1,372.2	1,288.2	1,149.0	1,039.0	5,890.0

¹ Using LEDs only, not LED/incandescent lamp combinations.

Sources: Auto Research Analysts and ABOUT Automotive.

CHMSL LED forecast

The real growth is occurring in Europe

Today, about 94% of cars built in Western Europe have an LED CHMSL. As the cost of LEDs has fallen, carmakers have switched from fitting CHMSLs with bulbs to LEDs. In North America, however, about 42% of all CHMSLs are fitted with an array of LEDs. CHMSLs have been standard equipment on all new passenger cars sold in the US since model year 1986 and all new light trucks since model year 1994. The first LED CHMSL appeared on the 1984 Corvette while the 2000 Cadillac DeVille featured North America's first all-LED rear lamp cluster.

The following two tables set out our estimates and forecast market fitment and value of red LED CHMSLs from 2003 through 2012. While the Western European market has almost reached maturity, the North American and Japanese markets are showing steady growth in the use of CHMSLs.

In terms of growth across all markets, the main driver is cost. Although in the US there has been a law in existence for the past 15 years requiring a third brake light, the majority of CHMSLs still use incandescent bulbs. But due to tumbling costs, manufacturers are gradually switching to LED CHMSLs.

Although the North American LED CHMSL market is growing, the real growth is occurring in Europe, as a lighting manufacturer said: "The Americans are offering greater styling [using LEDs] whereas Europeans are improving the technology." European laws requiring a third brake light were passed later than in North America, however, due to styling reasons the LED CHMSL market has grown at a faster rate.

Table 5: LED red CHMSL percentage fitment rates for passenger cars and light trucks, Western Europe, Japan and North America, 2003 - 2012 (Percentage fitment)

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Western Europe	92	93	94	95	96	97	98	99	100	100
Japan	25	26	27	28	29	30	31	32	33	28
North America	40	41	42	43	44	45	46	47	48	48

Sources: Auto Research Analysts and ABOUT Automotive.

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