Changing the Light Bulb

No Joke: LED Technology Fuels Fast Growth in Once-Staid Industry

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The future of lighting is in chips.
Light-emitting diodes—those tiny, chip-based
lights that for years have served as the power
indicator on stereos and coffee-makers—are
shaking up the global lighting industry like noth-
ing since fluorescent bulbs emerged just after World War II.

The spread of LEDs into a wider array of products poses
new challenges for Philips Electronics NV, of Amsterdam:
Siemens AG's Osram unit, based in Munich,
Germany; and General Electric Co., of Fair-
field, Conn. The three have dominated every
step of making a light bulb, from tungsten
mining to retail promotions, for more than a
century. But the LED arena is wide open, with
the big multinationals going up against
start-up manufacturers in core chip technol-
ogy and against niche producers of finished
products—far more competition than they
faced in traditional lighting.

A traditional light bulb uses an electrified
wire filament in a vacuum tube. An LED, on the
other hand, is a semiconductor chip that, when
zapped with electricity, emits light. The color of
the light depends on the material at the base of the chip. Like
computer chips, LEDs can be very small—several could fit
on fingernail—and they can be programmed by software to
light up, for example, a stadium scoreboard.

Such flexibility first pushed LEDs into applications
where traditional bulbs wouldn't work. Now, high-power
LEDs are taking the place of bulbs, showing up in cell-
phones, cars, televisions and elsewhere in homes, the
light bulb's stronghold.

LEDs consume less electricity than many other types of
lights and last longer than most—around 10 years or so.
Like other types of chips, their cost is falling and perform-
ance is improving as manufacturers make ad-
vances in materials and factory processes.

"It's going to open up and revolutionize the
way we use and think about lighting," says
Robert Steele, an analyst with Strategies Un-
limited, a U.S. market-research firm that spe-
cializes in LEDs.

Cellphones are the biggest new LED mar-

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Philips Electronics' LED light 'bulbs' (far left
and right); change color when squeezed;
Miami Dolphins' end-zone screen (above);
Coke's ad in Times Square.
LED Technology Heats Up Staid Lighting Industry

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ket, lighting up keypads and liquid crystal displays. (Computer screens, in contrast, rely on fluorescent bulbs for light.) Sales of high-brightness LEDs, the kind used in the new products, are estimated to be $4 billion to $5 billion this year. Sales are expected to hit $10 billion by the end of the decade.

Among the new applications fueling LED growth: Drivers of the new Ford Motor Co. Mustang can use the "MyColor" feature to change the color of the lighting on their LED-laden dashboard. (A small line of red, green and blue LEDs can, in varying combinations, produce 125 colors.)

Boeing Corp. plans to use LEDs throughout the interior of its new 787 Dreamliner commercial jet, creating lighting environments that are supposed to help international travelers adjust to time-zone changes. Owners of a Louisville, Ky., restaurant, Proof on Main, eliminated dangling light bulbs and replaced them with LED lighting that changes from amber in the morning to violet late at night. Already, some traffic signals in cities in the U.S. and China use LED fixtures that switch between red, yellow and green, instead of separate colored bulbs.

Philips is selling flameless candles, with LEDs providing the "flickering" light source. It also is experimenting with LED-based lights in the shape of bulbs that fit into existing lamps and offer a twist: Squeezing or tapping the bulb turns it on or off, or makes it change color. (LEDs don't get hot because they use so little energy.) And Philips is developing a remote-controlled LED room-lighting system.

LEDs' rising influence is most visible in the growth of companies working on the basic technology. Philips Electronics' Lumileds, Nichia Chemical Corp. and Toyota Gosei Co., of Japan, and Cree Inc., of Durham, N.C., produce LED chips and sell them to firms that build finished lights. In Asia, some packages for LED flashlights made by Energizer Holdings Inc. are marked "LED by Nichia"—a marketing ploy similar to the "Intel Inside" sticker on a computer.

Some start-ups are establishing early leads in market niches. Canada's Carmanah Technologies Corp. married LEDs with solar panels for marine buoys. It later expanded into aviation, selling easy installation runway lights to the U.S. military in Afghanistan and elsewhere.

The technology has driven Daktronics Inc. of Brookings, S.D., the largest U.S. maker of scoreboards, into other types of outdoor signs, including some in New York's Times Square and London's Piccadilly Circus. And LEDs have replaced incandescent light bulbs on many high school scoreboards. "It's a much more cost-effective and much better energy source," says Chief Executive Jim Morgan.

Daktronics has edged ahead of an Asian rival, Lighthouse Technologies, of Hong Kong, in a race to make the biggest LED screen. Two months ago, Daktronics unveiled a 50-foot-high by 140-foot-wide screen for Dolphin Stadium in Miami, beating Lighthouse's 132-foot screen, which sits above touristy Nathan Road in Hong Kong.

A GE engineer, Nick Holonyak Jr., built the first LED in 1962, and the company patented the discovery. Among the first big uses for LEDs were calculators, and manufacturer Hewlett-Packard Co. eventually bought GE's patent.

But the technology remained on the fringes of industry for decades. Nichia and Cree changed that in the 1990s by broadening the LED color palette, which previously had been limited to red, yellow and green. The breakthrough came in 1993, when Nichia, Toyota Gosei (part-owned by Toyota Motor Co.) and, soon afterward, Cree conquered blue, marking the final step to creating combinations that would fill out the color spectrum, including white.

Major manufacturers took notice. In 1999, GE formed GE-Lumination, a venture with chip maker Emcore Corp., to get back into the LED business. The joint venture is looking to develop the perfect-white lighting system, which could be used as general illumination in retail stores, industrial buildings and, some day, homes.

"The game for us is white," says Michael Petras, vice president of GE's commercial- and industrial-lighting sales. "It's the lighting market."

Nichia remains the biggest force in overall production of LED chips. Leading in the production of high-powered chips are Osram Opto Semiconductors and Lumileds, a former joint venture of Philips Electronics and the Hewlett-Packard spinoff Agilent Technologies Inc. and now 100% owned by Philips. Gerard Kleisterlee, Philips' CEO, says one need only look at the history of other electronics markets to know how varied the future may get.

"We were founded around the manufacture of incandescent light, and that vacuum tube produced other vacuum tubes for radios and picture tubes for TV," Mr. Kleisterlee says. Radio tubes gave way to transistors, and TV tubes to liquid-crystal displays. "Now," he says, "finally that same thing starts to happen to lighting."