NanoMarkets Report

Smart Lighting Markets – 2014

Vol. 2: Products, Companies and Technologies

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SUMMARY

NanoMarkets has been covering the smart lighting market for four years and has acquired an understanding of the key markets, technologies and companies in this rapidly expanding business. This year, NanoMarkets has decided to cover this interesting sector in two volumes. Volume I is devoted to an analysis of smart lighting markets and covering the basic drivers and economics of the smart lighting business. Volume II provides coverage of the leading companies, products and technologies that play in the smart lighting market place.

Together both volumes identify where and how the new business for smart lighting systems will appear over the next eight years as the developed world replaces its lighting infrastructure with solid-state lighting (SSL), especially LEDs.

While many smart lighting systems can control compact fluorescent lights (CFLs), there is little doubt that the smart lighting products of the future will be primarily intended for LED control. This is not just because LEDs are the "lighting of the future," but also because they potentially permit very high levels of control compared with previous generations of lighting. With this in mind, this report examines how the latest control and sensor technologies will impact the development of future smart lighting products.

Many existing smart lighting systems are intended primarily to add to LEDs' already impressive energy efficiency. This makes strategic sense given current concerns about rising real energy prices. However, NanoMarkets believes that with the market becoming crowded, suppliers of smart lighting systems will need to find new ways to differentiate themselves in the market, either by (1) exploring new end-user markets such as street lighting or auto lighting, or (2) adding new functionality such as health and mood lighting or even visible light communications (VLC). The latest lighting research indicates that smart lighting can also lead to improved health and mood, while newer technology is showing the way to using smart lighting systems for air quality monitoring and even the delivery of information services.

While smart lighting systems have evolved as standalone products, NanoMarkets notes that, in this Internet-of-Things era, the smart lighting business must be seen as part of a bigger picture. In particular, in this report we discuss the opportunities that are expected to emerge as smart lighting systems increasingly interface with building and home automation products.

In this year's reports, we have considerably extended the report coverage to include analysis beyond the energy-saving features of smart lighting to other business opportunities that the arrival of smart lighting is creating. This is—in particular—the focus of Volume I. But as with NanoMarkets' previous report on smart lighting, our 2014 reports show how new value is being created in the lighting market by adding enhanced electronics and intelligent luminaires and how such product strategies will be able to build on the massive trend towards introducing LED lighting.

Also included in Volume II is an analysis of the smart lighting strategies of the firms that NanoMarkets expects to see as major players in the smart lighting space. We examine what the prospects for start-ups are in this space. And in Volume I there is an eight-year market forecast with breakouts by type of product, end-user market segment, and the regions/countries where smart lighting will be sold.

Because of our years of coverage in this field, NanoMarkets believes that our 2014 reports provide the best information and analysis available on the current trends in the smart lighting sector. We include a detailed eight-year forecast with breakouts by functionality and type of end user, as well as analyses of product/market strategies being deployed by leading firms in the smart lighting space. We believe that these reports will prove of value to executives throughout the lighting, semiconductor, sensor and networking industries.

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Chapter One: Introduction

1.1 Background to this Report

The smart lighting market is undergoing a transition that we expect will lead to expanded opportunities for many different types of companies. The older generation of so-called smart lighting systems—really no more than lighting management systems—that were not much more than motion sensors and timers has evolved into systems that are much smarter. The smart home and smart office of the future that has existed in the imagination of writers and futurists seems really to now be on the horizon, thanks to advances in technology that are leading to the availability of more features at lower prices.

Several trends that NanoMarkets highlighted in our 2013 smart lighting report have recently become even more relevant. The primary among these is increased use of LEDs, driven by both technology improvements in LEDs and regulations aimed at increasing energy efficiency in lighting.

One of the main selling points about smart lighting has always been its ability to improve energy efficiency, and this remains an important aspect. Real energy costs remain high and are not likely to decrease any time soon and we are seeing more emphasis on the need to conserve energy and expand into alternative energy sources. Smart lighting continues to be boosted by this trend.

In order to continue its potential market growth and profitability trajectory, however, smart lighting will need to evolve technologically and smart lighting providers will need to differentiate themselves in the market and create products that offer more than just a lower energy bill. Companies are working in that direction with systems that add features not previously available:

- **Lighting to improve health and mood.** While this is not yet available in commercial systems, the technology is ready to launch and we expect to see more of this type of function available everywhere from hospitals (which will probably be the earliest adopters) to office buildings. We think that 2014 and 2015 will be the take-off years for such products.

- **Improved connectivity.** This includes the trend toward more options for wireless systems, different options for Internet connectivity (central control versus connectivity for each individual light fixture), and compatibility with the cloud for collecting and distributing data. This is a differentiating feature for smart lighting systems but also brings the smart lighting business into conformance with the Internet-of-Things (IoT) meme.

1.1.1 LED Adoption Driving Changes in Smart Lighting

The primary technology change driving the evolution of smart lighting is improvements in LEDs and their increased usage in lighting systems of all kinds. This trend has been brewing for a while but is now reaching a tipping point. Lighting management systems have been around for many years and have been—and still are—available for CFL and even incandescent lighting.

Nonetheless, smart lighting is being increasingly associated with LED-based lighting, which makes sense. LEDs are semiconductor devices and therefore inherently more controllable than incandescent or fluorescent bulbs. It is possible to integrate control and communication hardware and software directly into the bulbs, something that wasn't an option with older types of lighting. In addition, LEDs have been strongly touted as, above all, energy efficient. NanoMarkets' sense of the market is that when LEDs reach a certain stage of technological maturity (and lower prices points) they will quickly replace CFLs as the way to go in energy-efficient lighting. So LEDs are increasingly what smart lighting is all about because of both their controllability and their inherent energy efficiency.

One example is improved color control for both cool and warm white light. This is enabling a new generation of smart lighting systems that takes into consideration the effects of lighting on health and mood and are designed to specifically address those needs. LEDs can also allow for extremely precise color control. It remains to be seen how fine this control needs to be to achieve beneficial effects; it warrants further study to determine how to best use the capabilities of LEDs to improve health and mood.

In addition, although LEDs have been available for some time, they are now producing a quality of light that is helping them overcome the perception of LEDs as cold and dull. Advances in LEDs themselves is beyond the scope of this report, but these advances have helped expand their use and therefore expand the possibilities of smart lighting.

1.1.2 New Regulations and Guidelines Affect Lighting

State and national regulations governing lighting definitely play a role in how the smart lighting industry has been evolving. The California Energy Commission's Title 24 standards are one example, which may inform how things are done in other parts of the U.S. and also the rest of the world.

With regard to the California regulations, new requirements governing energy efficiency took effect at the beginning of 2014, and they are much more stringent than the 2008 standards. All luminaires in commercial buildings need to incorporate

multi-level controls or continuous dimming. The new version of the standard also addresses daylighting controls and requires occupancy sensors in a wide range of indoor spaces, from offices to classrooms to indoor parking areas. Title 24 adds automatic scheduling controls to outdoor lighting systems, in addition to the photocontrols that were previously required. In effect this is a regulatory mandate requiring something resembling smart lighting.

The Title 24 residential code updates requirements for efficacy of luminaires and requires occupancy sensors for luminaires that do not meet the criteria. Although Title 24 only applies to installations in California, similar regulations exist in New York, and we expect a push toward increased regulations throughout the U.S. leading to national standards.

The New Buildings Institute also recently updated the International Energy Conservation Code (IECC) to include more stringent requirements for lighting. The 2015 IECC will build upon guidelines in the 2012 document regarding daylighting and lighting controls. Occupancy sensors and daylighting controls will now be required in more types of buildings, including warehouses. These types of requirements drive the industry to find more cost-effective ways to implement the rules and spur development of better products.

These regulations can help companies that produce smart lighting systems because customers no longer have a choice whether to implement energy-efficient lighting. But they do have a choice in which vendor to use, so it is important for companies to differentiate themselves in terms of design choices, features, and price points.

1.1.3 Evolving Market Strategies in the Smart Lighting Space

When NanoMarkets last published a report on smart lighting, the large lighting companies were for the most part not actively pursuing smart lighting, or at least were doing so only behind the scenes without making any public announcements about developments in that direction. Philips was possibly the exception, and we predicted that other lighting companies would follow suit. That has indeed come to pass, with all of the major lighting companies moving beyond luminaires into designing systems that enable communication between luminaires and incorporate a lot of the trends that we see happening in the smart lighting industry.

In the past year or so we have seen some consolidation in the industry, with several of the start-up firms we profiled in last year's report either going out of business or being acquired by larger lighting or control system firms looking to expand their offerings in smart lighting. This trend is likely to continue, especially with companies

like GE, Philips, and Osram showing an increased emphasis on smart lighting solutions that tie into what they already provide. In addition, NanoMarkets notes that we have also seen growing interest in smart lighting from outside the smart lighting sector proper:

- Semiconductor chip manufacturers have also long produced LED chips (drivers), but NanoMarkets is now seeing increasing interest in smart lighting in this sector. What is new in the past year is a greater emphasis on promoting chips that are specifically designed for smart lighting systems. Such chips may be embedded in an LED fixture or reside within a central controller.

- Similarly, lighting control systems firms have always used software to control their systems, but today's software does more than just control lights via a timing circuit. It controls precise dimming and sends data to local computers, or, in a trend we see growing significantly, to the cloud for remote access by building managers and others looking to track data and use them to optimizing system settings.

- Until recently, Honeywell was the only building automation company that had expanded into lighting in any measureable way. Merging building automation with lighting automation makes a lot of sense, but traditional building automation companies have not historically shown much of an interest in smart lighting applications. That is starting to change. Trane, for example, is now collaborating with GE to integrate lighting and building controls.

1.2 Objectives and Scope of this Report

In an effort to thoroughly cover developments in smart lighting, NanoMarkets has divided the 2014 Smart Lighting Report into two volumes. Volume I discusses market trends for indoor and outdoor smart lighting systems and provides in-depth forecasts for each relevant market segment.

This report, Volume II, delves into smart lighting technology. While ballasts, sensors, and controllers have been around a long time, today's systems are moving beyond simple motion sensors and timers and we discuss how the technology has evolved and look at where it is going in the future.

Our focus in this report is on the leading edge of smart lighting. We look at historical lighting systems only in the context of what today's and tomorrow's technology can

provide in comparison. There is still a market for older, mature technology, but it doesn't represent an opportunity moving forward. This report instead describes the technology behind the market opportunities discussed in Volume I.

The past year has seen an increase in wireless lighting networks, and we cover these in greater detail than in previous smart lighting reports. It is impossible today to talk about any type of network without relating it to the ubiquitous Internet of Things, and we discuss advances in what some are calling the Internet of Light.

A great number of companies are involved in smart lighting—this includes traditional lighting control firms, but large lighting manufacturers are increasingly getting involved in this space, and building automation manufacturers are considering it as well. LED chip manufacturers also play an important and growing role.

This report profiles a variety of companies involved in smart lighting, looking at their current product offerings, approach to smart lighting, and strategic plans for the future. Although Volume I has a greater focus on end applications, this volume gives the perspective on who is doing what and indirectly provides information about which applications are likely to be important moving forward. We analyze each company's prospects and provide insight into which companies or sectors are most likely to profit in the smart lighting sector.

Read together, Volumes I and II provide a full picture of the technologies, applications, and companies that are significant for the future of smart lighting and where the greatest opportunities lie over the next eight years.

1.3 Methodology of this Report

Information in this report comes from a variety of sources, including interviews with many of the companies profiled in the report and universities doing research into smart lighting. We also gathered information from secondary sources including company websites, press releases, government reports, trade press articles, and white papers.

In 2013 NanoMarkets released two reports on smart lighting: "Smart Lighting Markets and Opportunities 2013" and "Markets for Smart Lighting: Driver, Controller and Sensor Chips." This report draws on information from both reports. In all cases the information has been reviewed and reanalyzed in light of developments since NanoMarkets published those reports and updated accordingly.

The basic methodology used in forecasting for this report is the same as in all NanoMarkets reports. We have synthesized data from a wide variety of sources to paint a picture of what is going on in the smart lighting industry and have then identified and analyzed the trends in the industry with the goal of showing where the main opportunities will be found. Our forecasting methodology is described in detail in Volume I, where we include detailed forecasts for various segments of the market.

1.4 Plan of this Report

The structure of this report is somewhat different than other NanoMarkets reports because we are presenting it in two separate volumes. We have divided Volume II of Smart Lighting into three chapters plus an Executive Summary, which gives an overview of opportunities for various players in the smart lighting industry.

Chapter Two covers smart lighting technology, focusing especially on how the increased prevalence of LEDs affects everything from ballasts to networks. We look at trends in technology, such as the shift from only considering energy efficiency when designing a smart lighting system to looking at the effects of lighting on health and mood and how smart lighting can contribute to improved health and productivity.

Chapter Three profiles companies involved in the smart lighting industry and evaluates their strategies, offerings, and capabilities. Because of the nature of smart lighting, some of these companies are partnering together to offer complete solutions.