

LED LIGHTING MARKET

GLOBAL FORECAST TO 2022

BY INSTALLATION TYPE (NEW INSTALLATION, AND RETROFIT INSTALLATION),
END USE APPLICATION (INDOOR LIGHTING, AND OUTDOOR LIGHTING),
PRODUCT TYPE (LAMPS, AND LUMINAIRES), AND GEOGRAPHY

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LIST OF ABBREVIATIONS

ABBREVIATION	FULL FORM
APAC	Asia-Pacific
ASP	Average Selling Price
CAGR	Compound Annual Growth Rate
CMOS	Complementary-Metal-Oxide Semiconductor
DLP	Data Light Processing
EDA	Electronic Design Automation
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
HID	High Intensity Discharge
IDMs	Integrated Device Manufacturers
LCoS	Liquid Crystal on Silicon
LCD	Liquid Crystal Display
LED	Light-Emitting Diode
MEMS	Microelectromechanical Systems
MRI	Magnetic Resonance Imaging
ODM	Original Design Manufacturer
OEM	Original Equipment Manufacturer
OLED	Organic Light-Emitting Diode
POC	Point-of-Care
R&D	Research & Development
RoW	Rest of the World
U.K.	United Kingdom
USD	United States Dollar
U.S.	United States
Y-o-Y	Year-on-Year Growth

1 INTRODUCTION

1.1 OBJECTIVES OF THE STUDY

- To define, describe, and forecast the global LED lighting market, in terms of value and volume, segmented on the basis of installation type, product type, end-use application, and geography.
- To forecast the market size, in terms of value and volume, for various segments with regard to four main regions, namely, North America, Europe, Asia-Pacific, and RoW
- To provide detailed information regarding the major factors influencing the growth of the market (drivers, restraints, opportunities, and industry-specific challenges)
- To provide a detailed overview of the value chain in the LED lighting market and analyze the impact of Porter's five forces on the market
- To strategically analyze the micromarkets¹ with respect to the individual growth trends, future prospects, and contribution to the total market
- To analyze the opportunities in the market for various stakeholders by identifying the high-growth segments of the LED lighting market
- To strategically profile the key players and comprehensively analyze their market position in terms of ranking and core competencies² along with the detailed competitive landscape for the key market leaders
- To analyze competitive developments such as joint ventures, mergers and acquisitions, new product launches and developments, and research and development in the LED lighting market

1.2 MARKET DEFINITION

A light-emitting diode (LED) is a semiconductor light source formed from a p-n junction diode. It emits light when a suitable voltage is applied across its leads. An LED lamp is formed by assembling LED devices into a lamp to be used as a light bulb or light source in a lighting fixture.

Compared with incandescent lamps, LED lamps are several times electrically efficient and have a longer lifespan. They are also significantly more efficient than fluorescent lamps, and unlike fluorescent lamps, LEDs do not require warm-up time to come to full brightness. An LED lighting system's essential component is an LED driver. An LED driver is an electrical device which monitors the power to an LED or a series of LEDs. LED driver responds according to the changing needs of the diode or LED circuit by providing it a constant quantity of power.

1. Micromarkets are defined as the further segments and subsegments of the LED lighting market included in the report.

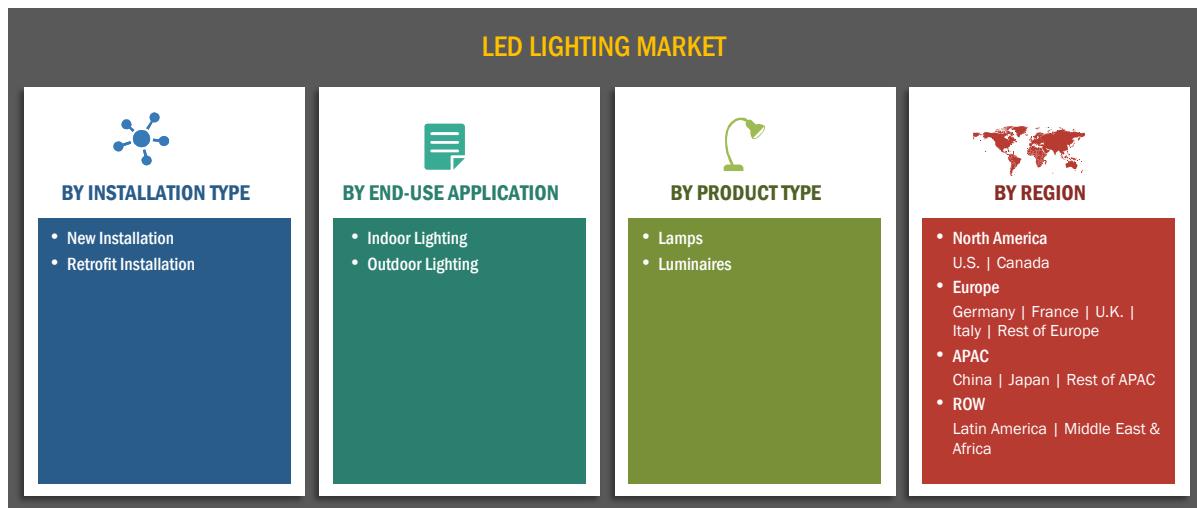
2. Core competencies of companies are defined in terms of their key developments, SWOT analysis, and key strategies adopted by them to sustain their position in the market.

1.3 STUDY SCOPE

1.3.1 MARKETS COVERED

The report covers both the demand and supply sides of the LED lighting market. The supply-side market segmentation includes installation type and product type, while the demand-side segmentation includes end-use application and geographical regions. The following diagram gives an overview of the segments covered in the report.

FIGURE 1 MARKET SEGMENTATION



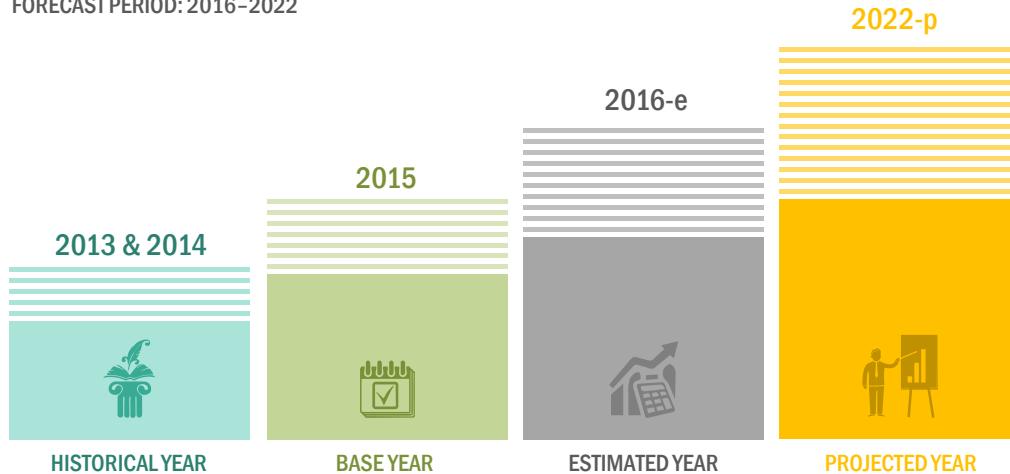
Note 1: Rest of Europe includes Spain, Russia, Netherlands, Switzerland, Belgium, and Scandinavian countries among others

Note 2: Rest of APAC includes South Korea, India, Australia, Indonesia, Thailand, Vietnam, and Singapore among others

Source: Experts' Interviews and MarketsandMarkets Analysis

1.3.2 YEARS CONSIDERED FOR THE STUDY

FORECAST PERIOD: 2016–2022



Note 1: The base year considered for the company profiles is 2015. Wherever the information for the base year was not available, the year prior to the base year has been considered.

Note 2: e = estimated; p = projected.

1.4 CURRENCY

The currency used in the report is U.S. dollars, with market size indicated in USD million.

- For companies reporting their revenue in U.S. dollars, the revenue has been sourced from their annual reports.
- For companies reporting their revenue in other currencies, the average annual currency exchange rate has been used for that particular year to convert the value into U.S. dollars.

1.5 PACKAGE SIZE

The market size in terms of volume has been indicated in million units.

- 1 million units = 1,000,000 units

1.6 LIMITATIONS

- Recent financials have been provided for publicly listed companies; financials for privately held companies have not been provided in the report.
- This report does not cover the LED lighting market in terms of raw materials used for making die, packaging technologies, and luminaries.
- Lighting controls have not been taken into consideration for the LED lighting market.
- The report covers the LED lighting market only in the general lighting industry and not automotive lighting and backlighting sectors.

1.7 STAKEHOLDERS

The intended audience for this report includes:

- Original equipment manufacturers (OEMs)
- OEM technology solution providers
- Research institutes
- Market research and consulting firms
- Lighting manufacturers
- Lighting control system manufacturers
- Forums, alliances, and associations
- Technology investors
- Governments and financial institutions
- Analysts and strategic business planners
- End users who want to know more about the technology and the latest technological developments in the industry

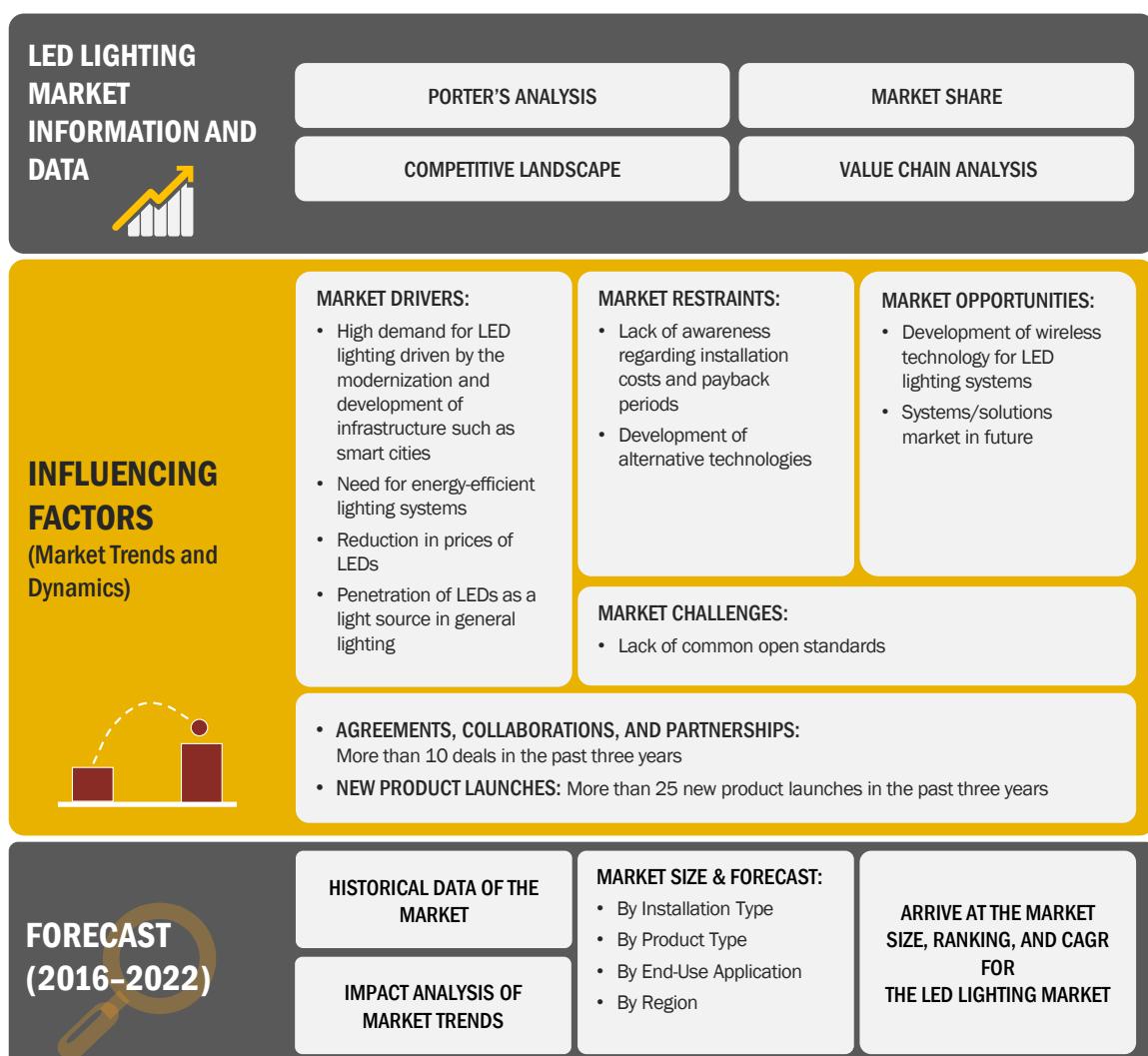
2 RESEARCH METHODOLOGY

2.1 RESEARCH DATA

This section of the report helps in understanding the methodology implemented during the development of the LED lighting market report. There are two basic sources of information—secondary and primary—that have been used to identify and collect information for an extensive technical and commercial study of the LED lighting market. Secondary sources include company websites, magazines, associations, and databases (OneSource, Factiva, and Bloomberg). Primary sources which include key opinion leaders from various industry verticals such as lighting, electronics and semiconductor manufacturing, and others have been interviewed to understand, obtain, and verify critical information as well as assess future market trends and prospects. The key players in the LED lighting market have been identified through secondary research and their market share has been determined through primary and secondary research. This research includes interviews with key opinion leaders such as CEOs, directors, and marketing personnel and the study of annual reports of market players to identify the top players.

The following illustrative figure shows the market research methodology applied in the making of this report.

FIGURE 2 LED LIGHTING MARKET: RESEARCH DESIGN



In the secondary research process, various secondary sources have been referred to for identifying and collecting information relevant to this study. The secondary sources include annual reports, press releases, and investor presentations of companies; white papers, certified publications, and articles from recognized authors; directories; and databases. Secondary research has been conducted to obtain key information about the industry's supply chain, market's value chain, total pool of key players, market classification and segmentation according to industry trends, geographic markets, and key developments from both market- and technology-oriented perspectives.

In the primary research process, various primary sources from both supply and demand sides have been interviewed to obtain the qualitative and quantitative information relevant to this report. Primary sources from the supply side include experts such as CEOs, vice presidents, marketing directors, technology and innovation directors, application developers, application users, and related executives from various key companies and organizations operating in the LED lighting market.

After the complete market engineering (including calculations for market statistics, market breakdown, market size estimations, market forecasting, and data triangulation), extensive primary research has been conducted to verify and validate the critical market numbers.

Primary research has also been conducted to identify segmentation types, industry trends, and key players, and analyze the competitive landscape and key factors affecting the market dynamics such as drivers, restraints, opportunities, and challenges. In the complete market engineering process, both top-down and bottom-up approaches have been used along with several data triangulation methods to estimate and forecast the market, including the overall market segments and subsegments listed in this report. Extensive qualitative and quantitative analyses have been performed on the complete market engineering process to list the key information/insights throughout the report.

2.1.1 SECONDARY DATA

Secondary sources referred to for this research study include government sources, corporate filings (annual reports, investor presentations, and financial statements), and trade, business, and professional associations. The secondary data has been collected and analyzed to arrive at the overall market size, which has been further validated through primary research.

2.1.1.1 Major secondary sources

Source	Web Link
Global Lighting Association	http://www.globallightingassociation.org/
Lighting Controls Association	http://lightingcontrolsassociation.org/
LEDinside	http://www.ledinside.com/

2.1.1.2 Key data from secondary sources

PARAMETER	SOURCE
MARKET SIZE	<ul style="list-style-type: none"> • Company Financials • Magazines • Journals • Press Releases • Paid Databases • MarketsandMarkets Data Repository
REVENUE OF COMPANIES	<ul style="list-style-type: none"> • Annual Reports • Company Websites • Public Databases • MarketsandMarkets Data Repository
QUALITATIVE INFORMATION (Market Dynamics, Market Trends)	<ul style="list-style-type: none"> • Company Websites • Annual Reports • Press Releases • MarketsandMarkets Data Repository

2.1.2 PRIMARY DATA

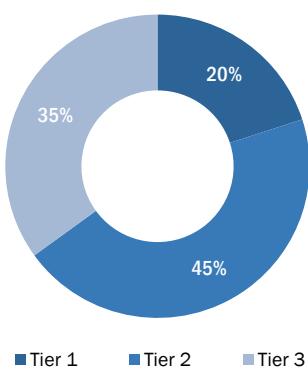
Extensive primary research has been conducted after understanding and analyzing the LED lighting market scenario through secondary research. Several primary interviews have been conducted with key opinion leaders from both demand- and supply-side vendors across four major regions, namely, North America, Europe, Asia-Pacific, and Rest of the World (South America, Middle East, and Africa). Approximately 25% of the primary interviews have been conducted with the demand side and 75% with the supply side. This primary data has been collected mainly through telephonic interviews, which consist 80% of total primary interviews; however, questionnaires and e-mails were also used to collect the data.

2.1.2.1 Primary interviews with experts

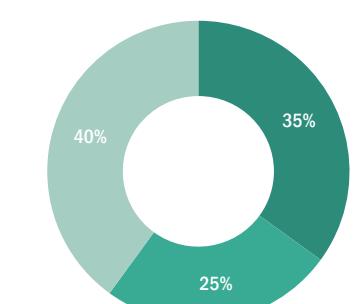
Value Chain	Intended Participants and Key Opinion Leaders	Interviews
Supply and Demand Sides (Time Spent on Interview)	Providers of LED lighting components and services	10-12
	LED lighting applications and end users in different geographies	3-5
	Industry consultants and LED lighting experts	2-4
	Government and regulatory bodies	1-3
	Total number of primary interviews conducted	16-25

2.1.2.2 Breakdown of primaries

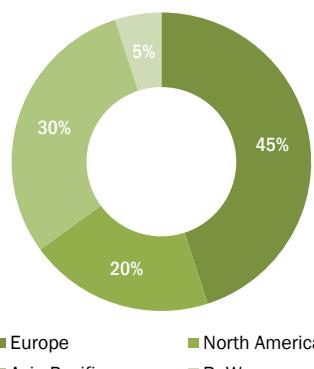
BY COMPANY TYPE



BY DESIGNATION



BY REGION



Note: The three tiers of the companies have been defined on the basis of their total revenue as of 2014; Tier 1 = >USD 10 billion, Tier 2 = USD 1 billion–USD 10 billion, and Tier 3 = <USD 1 billion.

2.1.2.3 Key data from primary sources

TYPE	PARAMETER	KEY DATA
GEOGRAPHIC SPLIT	<ul style="list-style-type: none"> Overall Market and Subsegments in 2015 CAGR of Each Region During the Forecast Period (2016–2022) 	<ul style="list-style-type: none"> Global LED Lighting Market, by Geography—North America, Europe, Asia-Pacific, and RoW
GLOBAL MARKET SIZE	<ul style="list-style-type: none"> Global Market Size for 2015 CAGR for the Forecast Period (2016–2022) 	<ul style="list-style-type: none"> Global LED Lighting Market LED Lighting Market, by Subsegment
MARKET SPLIT	<ul style="list-style-type: none"> LED Lighting Market, by Installation Type LED Lighting Market, by Product Type LED Lighting Market, by End-Use Application 	<ul style="list-style-type: none"> New Installation and Retrofit Installation Lamps and Luminaires Indoor Lighting and Outdoor Lighting

2.1.3 SECONDARY AND PRIMARY RESEARCH

The below figure illustrates the secondary and primary research process.



2.1.3.1 Key industry insights

“ The growing focus on reducing energy consumption is the key driver for the LED lighting market. **”**

CEO, Leading Electronics Control Company

“ The LED lighting market is currently small compared with the general lighting market, but its penetration would increase in the next 10 years owing to growing investments and government promotion. **”**

Sales Director,
Leading LED Lighting Company

Source: Industry Experts and Primary Interviews

2.2 MARKET SIZE ESTIMATION

In this report, both top-down and bottom-up approaches have been used to estimate and validate the market size of the LED lighting market and various other dependent submarkets. The key players in the LED lighting market have been identified through secondary research and their market share in the respective regions has been determined through primary and secondary research. This entire research methodology includes the study of annual and financial reports of top players as well as interviews with experts such as CEOs, VPs, directors, and marketing executives for key insights (both quantitative and qualitative). All percentage shares, splits, and breakdowns have been determined using secondary sources and verified through primary sources. All the possible parameters that affect the markets covered in this research study have been accounted for, viewed in detail, verified through primary research, and analyzed to obtain the final quantitative and qualitative data. This data has been consolidated and supplemented with detailed inputs and analysis from MarketsandMarkets and presented in this report. The figures given below show the overall market size estimation process employed for the purpose of this study.

2.2.1 BOTTOM-UP APPROACH

The bottom-up approach has been employed to arrive at the overall size of the LED lighting market from the revenues of the key players and their share in the market. Calculations based on the revenue of the key players identified in the market led to the overall market size.

2.2.1.1 Approach for capturing market share of application by bottom-up analysis (demand side)

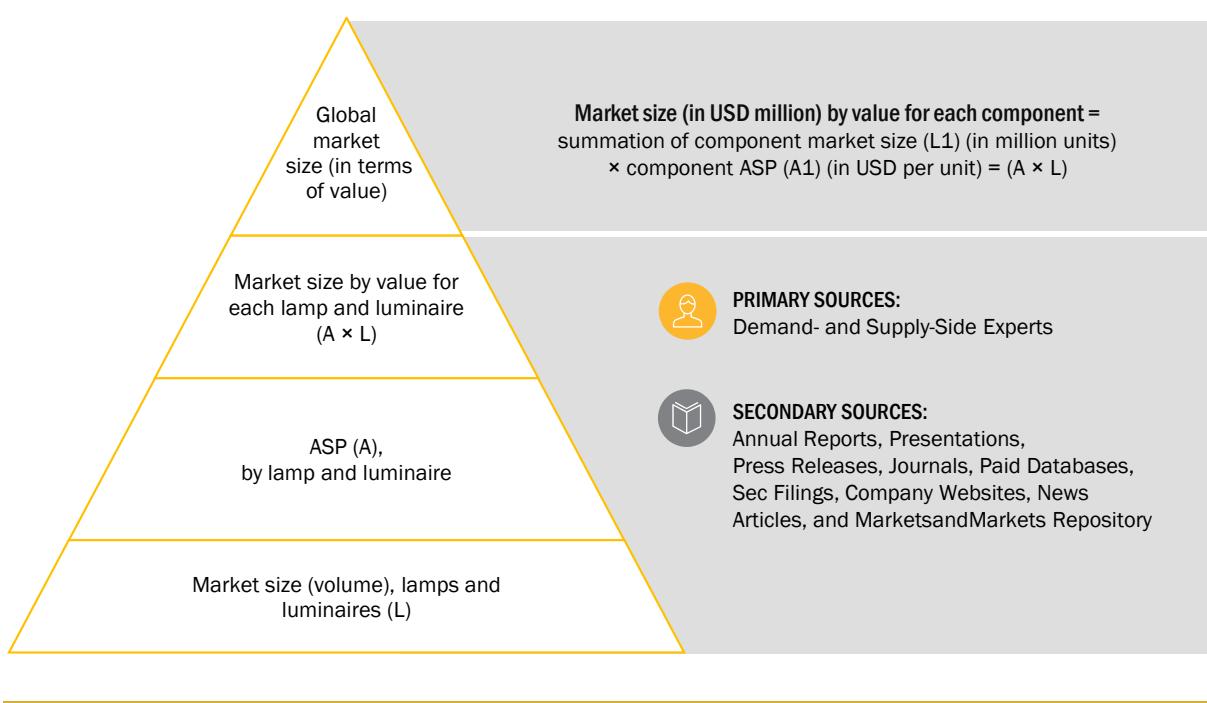
Various industries that have adopted or are expected to adopt LED lighting along with the related services were identified.

Each of these industries, along with related major companies and their system integrators, was analyzed to identify providers of LED lighting components and systems.

Demand generated by the industries for LED lighting in different applications was analyzed.

Size of the LED lighting market in each application was estimated based on the demand.

Ongoing and upcoming implementation of LED lighting by various companies across industries was tracked to forecast the market based on these developments and other critical parameters.

FIGURE 3 MARKET SIZE ESTIMATION METHODOLOGY: BOTTOM-UP APPROACH

Approach for capturing market share of each application with the help of various players in the value chain of the LED lighting market

Multiple discussions with key opinion leaders have been carried out to understand the type of contracts, services, lighting products and services, components, and subcomponents deployed by LED lighting providers for each industry. This helped in analyzing the breakup of scope of work carried out by each major LED lighting provider.

Market estimates were arrived by analyzing the market for LED lighting providers from different regions and countries, and then it was combined to get the market estimate by region.

At every level, the estimate would be verified and cross-checked by discussion with key opinion leaders such as CEOs, directors, and operations managers and finally with domain experts based within MarketsandMarkets.

This process entailed studying various paid and unpaid sources of information such as annual reports, press releases, white papers, and databases.

2.2.2 TOP-DOWN APPROACH

In the top-down approach, the overall market size has been used to estimate the size of the individual markets (mentioned in the market segmentation) through percentage splits from secondary and primary research.

For the calculation of specific market segments, the most appropriate immediate parent market size has been used to implement the top-down approach. The bottom-up approach has also been implemented for the data obtained from the secondary research to validate the market size of various segments.

2.2.2.1 Approach for capturing market share of application by top-down analysis (supply side)

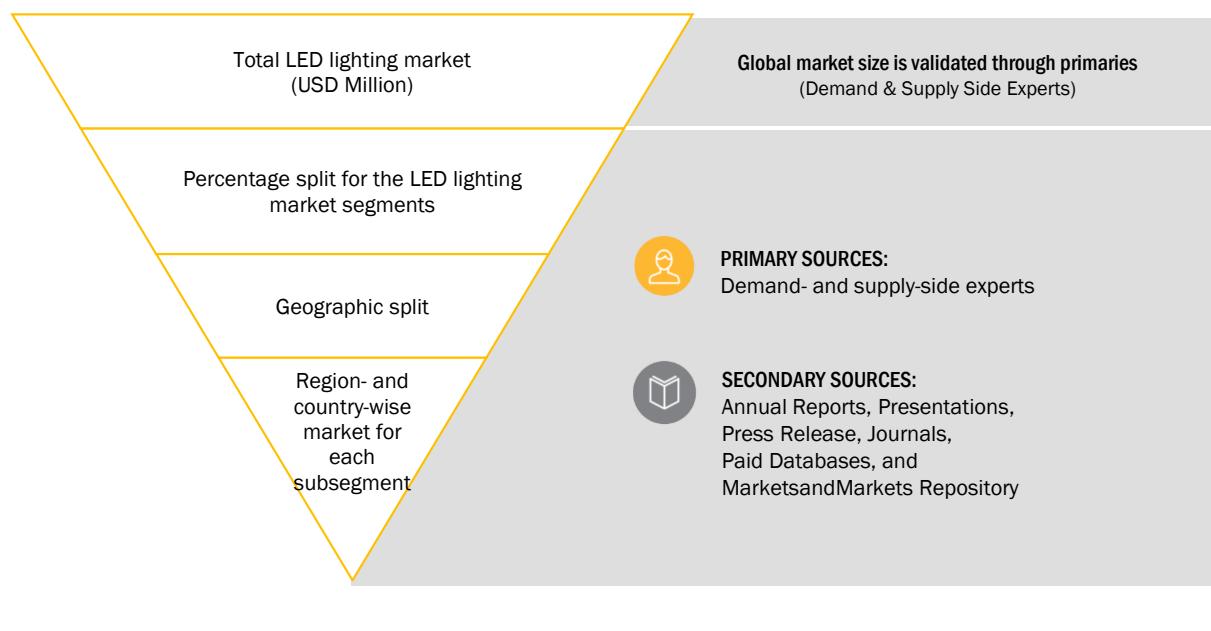
MarketsandMarkets focused on the top-line investment and expenditure by key players in the ecosystems of various industries for new installations and upgradation of LED lighting components and subcomponents and development in key market areas.

Information related to market revenue offered by the key LED lighting component and system providers was then built and developed.

Multiple on-field discussions with key opinion leaders were carried out across major companies involved in the development of LED lighting components and service providers.

Geographic splits were estimated using secondary sources, based on various factors such as number of players in a specific country and region, type of components, level of services offered, and type of standards implemented at the production floor.

FIGURE 4 MARKET SIZE ESTIMATION METHODOLOGY: TOP-DOWN APPROACH

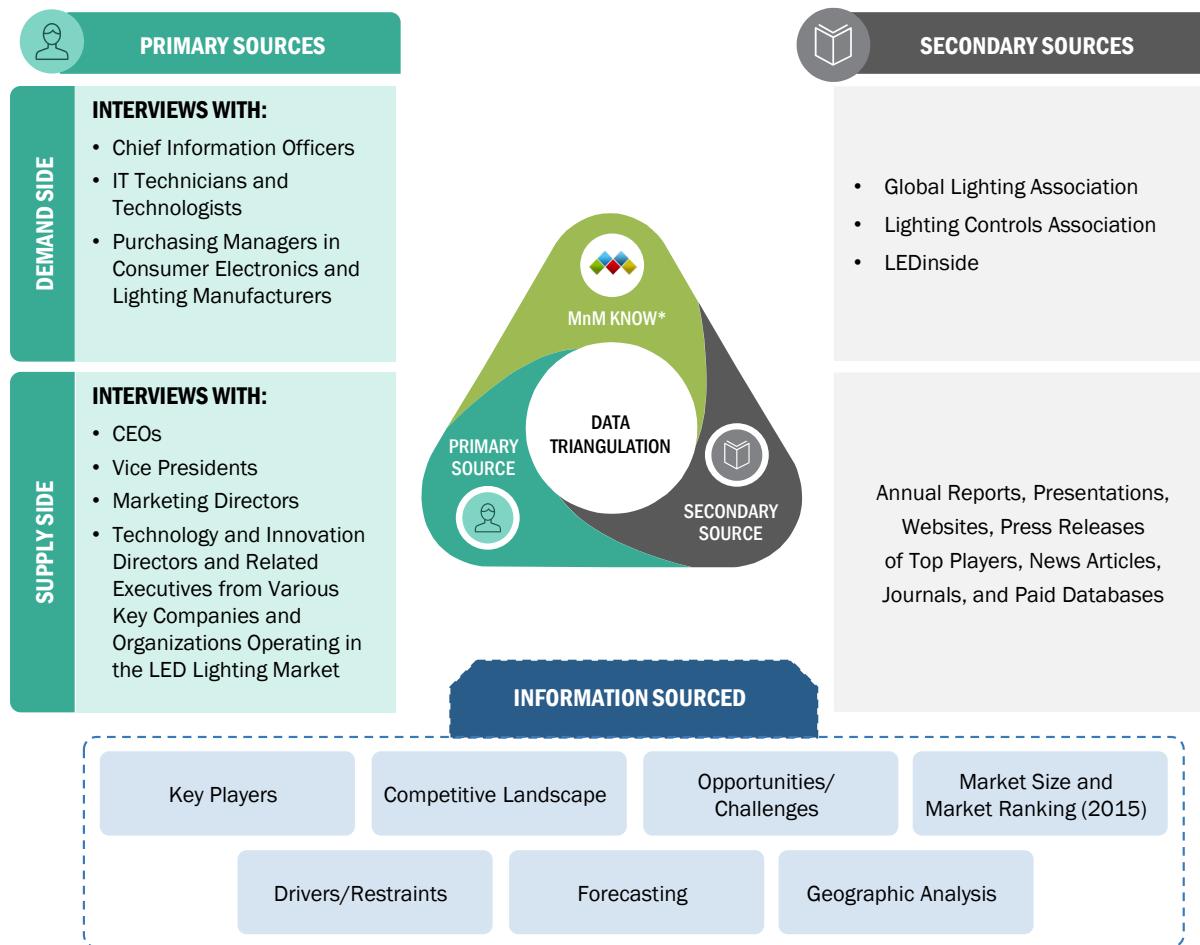


The market share of each company has been estimated to verify the revenue shares used earlier in the bottom-up approach. With the data triangulation procedure and validation of data through primaries, the overall parent market size and each individual market size have been determined and confirmed in this study.

2.3 MARKET BREAKDOWN AND DATA TRIANGULATION

After arriving at the overall market size from the market size estimation process explained above, the total market has been split into several segments and subsegments. The data triangulation and market breakdown procedures have been employed, wherever applicable, to complete the overall market engineering process and arrive at the exact statistics for all segments and subsegments. The data has been triangulated by studying various factors and trends from both demand and supply sides. The market has been validated using both top-down and bottom-up approaches.

FIGURE 5 DATA TRIANGULATION



MnM KNOW* stands for MarketsandMarkets' 'Knowledge Asset Management' framework. In this context, it stands for existing market research knowledge repository of over 5,000 granular markets, our flagship competitive intelligence and market research platform "RT", subject matter experts, and independent consultants. MnM KNOW acts as an independent source that helps us validate information gathered from primary and secondary sources.

2.4 RESEARCH ASSUMPTIONS

The following assumptions have been taken into consideration to complete the overall market engineering of the LED lighting market:

PARAMETER	ASSUMPTION
AUTHENTICITY OF DATA	Company revenue and segment-specific information have been obtained from the annual reports of the respective companies. The information provided in the annual reports has been assumed to be authentic.
GLOBAL ECONOMIC DOWNTURN	The global economy has been assumed to remain stable during the forecast period.
NICHE MARKET SEGMENTS	For niche market segments, where accurate data of the respective timeline was not available, the data was calculated using trend line analysis. In some instances, where mathematical and statistical models could not be applied to arrive at the number, generalization of trends in that particular market was done.
AVERAGE SELLING PRICE	Average selling prices (ASPs), wherever applied, were calculated using all kinds of suitable and mathematical methods and considering external qualitative factors affecting the prices.

3 EXECUTIVE SUMMARY

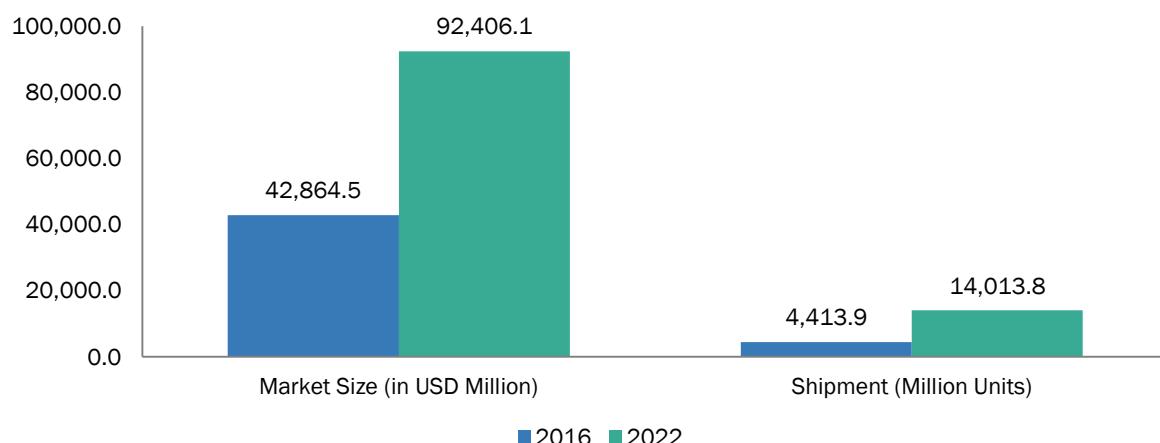
A light-emitting diode (LED) is a semiconductor light source formed from a p-n junction diode. It emits light when a suitable voltage is applied across its leads. An LED lamp is formed by assembling LED devices into a lamp to be used as a light bulb or light source in a lighting fixture. LED lighting consists of high-efficiency fixtures along with associated controls such as drivers and dimming switches which are able to adjust the lighting based on factors such as occupancy, daylight, and so on. LED lighting is being increasingly implemented to control growing energy consumption in buildings and outdoor areas such as highways, streets, and so on.

The governments of nearly all major economies have taken initiatives to implement LED lighting. The European Commission's 20-20-20 directive specifically focuses on reducing gas emissions to 20% of the 1990 level, thereby increasing the share of renewable energy consumption by 20% of the overall energy consumption and improving the energy efficiency to 20% across the European Union. According to the 20-20-20 directive, it has been estimated that energy-efficient lighting in buildings alone would avoid emission of around 12 million tons of CO₂ in Europe. According to the estimates of Energy Information Administration (EIA), in 2014, lighting constituted around 11% of the overall electricity consumption in the U.S.

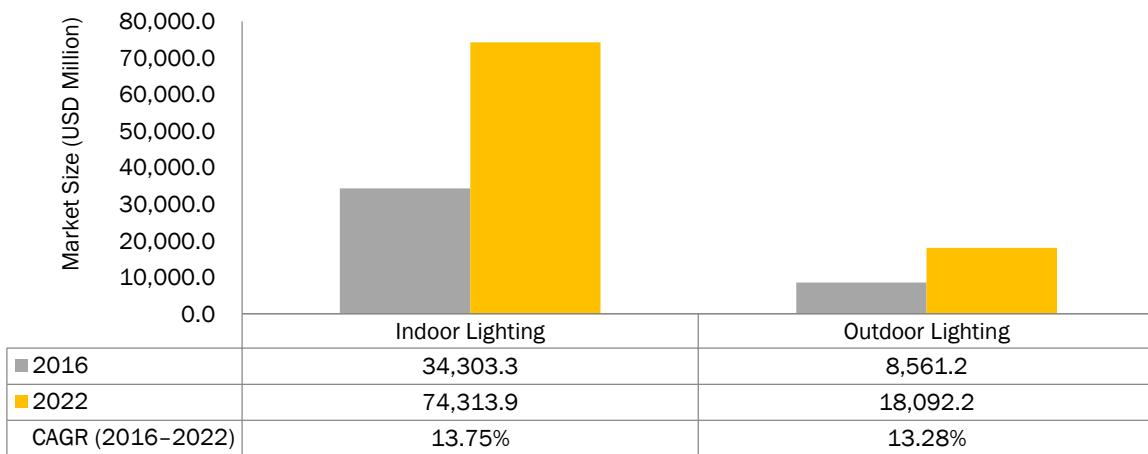
The LED lighting market was valued at USD 36.75 billion in 2015 and is expected to grow at a CAGR of 13.66% between 2016 and 2022. The major factors influencing the growth of the market are increasing demand for energy-efficient lighting systems, modernization and development of infrastructure such as smart cities, which leads to the implementation of lighting systems based on IoT, reduction in prices of LEDs, penetration of LEDs as a light source in general lighting, and the rapid rise of LED technology over conventional lighting technology.

Factors such as lack of awareness regarding installation costs and payback periods and the development of alternative technologies are inhibiting the growth of the LED lighting market. Development of wireless technology for LED lighting systems, rise of the systems/solutions market based on LED lighting, and increasing consumer awareness about the importance of energy saving are the major opportunities for the LED lighting market. However, lack of common open standards within the LED lighting industry is proving to be a challenge.

The global LED lighting market is dominated by players which manufacture LED lighting systems such as Philips Lighting Holding B.V. (Netherlands), General Electric Company (U.S.), OSRAM Licht AG (Germany), Cree, Inc. (U.S.), and Cooper Industries, Inc. (Ireland).

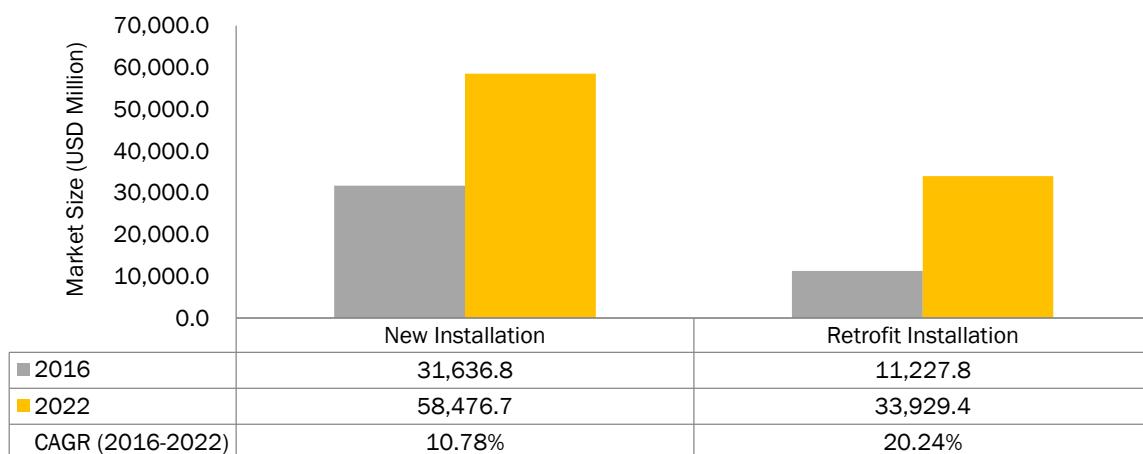
FIGURE 6 GLOBAL LED LIGHTING MARKET (VALUE AND VOLUME), 2016-2022

The LED lighting market, in terms of volume, is expected to register a shipment of 14,013.8 million units by 2022 from 4,413.9 million units in 2015, at a CAGR of 21.23% during the forecast period. This growth can be attributed to the growing adoption of LED-based lighting systems over traditional lighting systems, which is mainly driven by the increasing consumer demand for energy-efficient lighting systems such as LEDs.

FIGURE 7 INDOOR LIGHTING APPLICATION EXPECTED TO HOLD A LARGER SIZE OF THE LED LIGHTING MARKET BETWEEN 2016 AND 2022

Among the two applications, indoor lighting held a larger size of the market worth USD 34,303.3 million in 2015. The market for the highways and roadways outdoor lighting segment is expected to grow rapidly because of the growing spending on LED lighting systems by various government bodies.

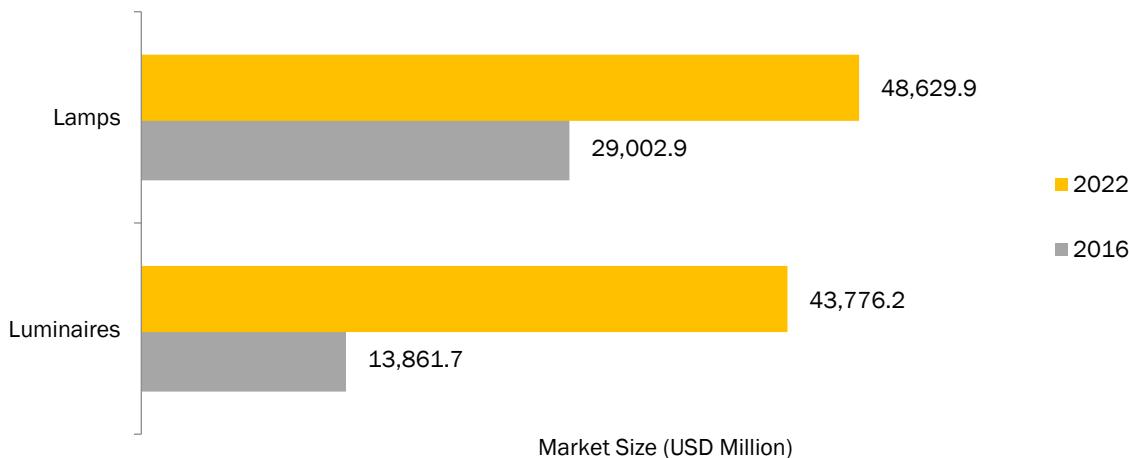
FIGURE 8 NEW INSTALLATION EXPECTED TO HOLD A LARGER SIZE OF THE LED LIGHTING MARKET DURING THE FORECAST PERIOD



Source: Press Releases, Investor Presentations, Annual Reports, Experts' Interviews, and MarketsandMarkets Analysis

New installation accounted for a share of ~74% of the LED lighting market in 2016; the market for the same was valued at USD 31,636.8 million in 2016 and is expected to grow at a CAGR of 10.78% between 2016 and 2022. The market for retrofit installation was valued at USD 11,227.8 million in 2015 and is expected to grow at a CAGR of 20.24% during the forecast period. The retrofit installations are growing at a high rate because more number of lamps of traditional lighting fixtures are being replaced with LED lamps than complete replacement of lamps and fixtures with new installations.

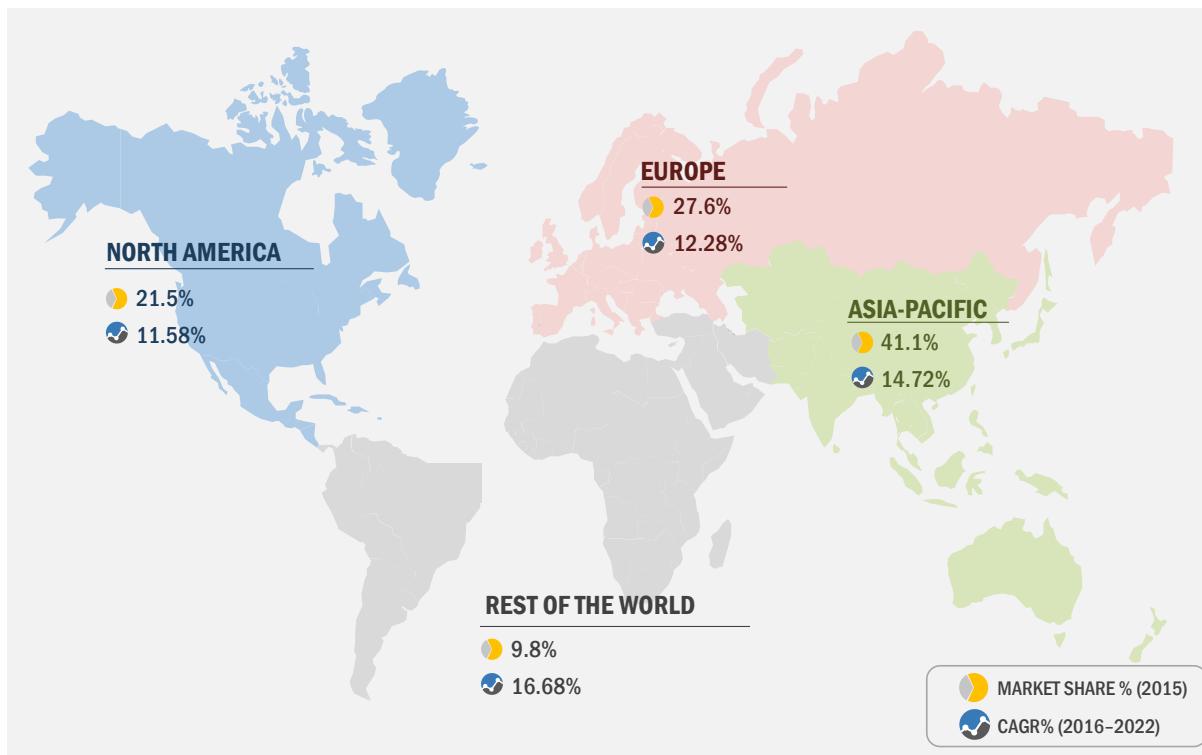
FIGURE 9 LAMPS EXPECTED TO HOLD A LARGER SIZE OF THE LED LIGHTING MARKET BY 2022



Source: Press Releases, Investor Presentations, Annual Reports, Experts' Interviews, and MarketsandMarkets Analysis

LED lamps currently hold a larger share of the LED lighting market and the same trend is expected to continue during the forecast period. The market for lamps was valued at USD 29,002.9 million in 2016 and is expected to grow at a CAGR of 9.00% during the forecast period. The LED lighting market for luminaires is expected to grow at the highest CAGR of 21.13% during the forecast period and reach USD 43,776.2 million by 2022 from USD 13,861.7 million in 2016.

FIGURE 10 ASIA-PACIFIC ACCOUNTED FOR THE LARGEST SHARE OF THE LED LIGHTING MARKET IN 2015



Source: Press Releases, Investor Presentations, Annual Reports, Experts' Interviews, and MarketsandMarkets Analysis

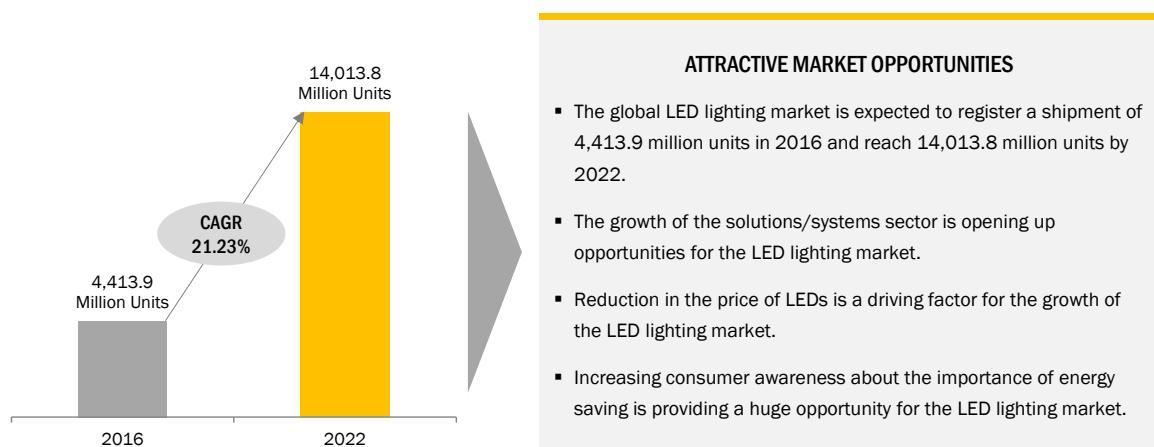
The LED lighting market has been segmented on the basis of geography into four major regions, namely, North America, Europe, APAC, and RoW. Each of these regions has been further segmented on the basis of individual countries. APAC accounted for ~41% share of the market in 2015, followed by Europe and North America with roughly 28% and 22% share, respectively. The RoW region has been segmented into Middle East and Africa and Latin America. The market in this region is expected to grow at a CAGR of 16.68% during the forecast period. The market penetration of LEDs in APAC is considerably high; APAC is expected to witness a high growth at a CAGR of 14.72% during the forecast period because of massive infrastructural projects initiated by the developing countries such as China, South Korea, and India. APAC is also home to one of the largest LED manufacturing bases in the world.

Europe has a population that has a relatively high standard of living, where the consumers are spending on smart homes of which LED lighting systems are an integral part. The European Union also has tough legislations regarding energy consumption. Owing to this, Europe is the second-largest market within the LED ecosystem.

4 PREMIUM INSIGHTS

4.1 ATTRACTIVE OPPORTUNITIES IN THE GLOBAL LED LIGHTING MARKET

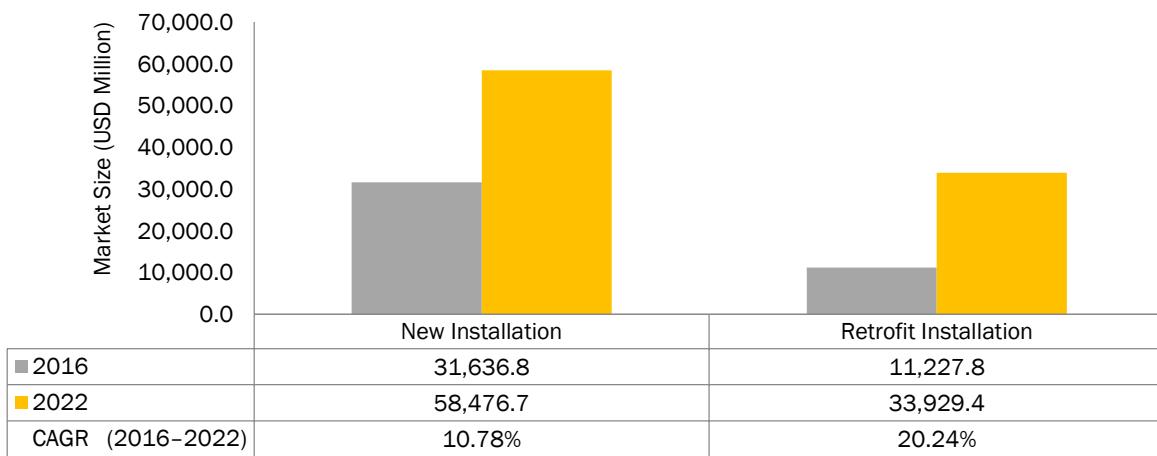
FIGURE 11 LED LIGHTING MARKET OFFERS LUCRATIVE OPPORTUNITIES Owing TO THE RAPID RISE OF THE NEW SOLUTIONS/SYSTEMS SECTOR



Source: Investor Presentations, Annual Reports, Press Releases, Experts' Interviews, and MarketsandMarkets Analysis

4.2 LED LIGHTING MARKET, BY INSTALLATION TYPE

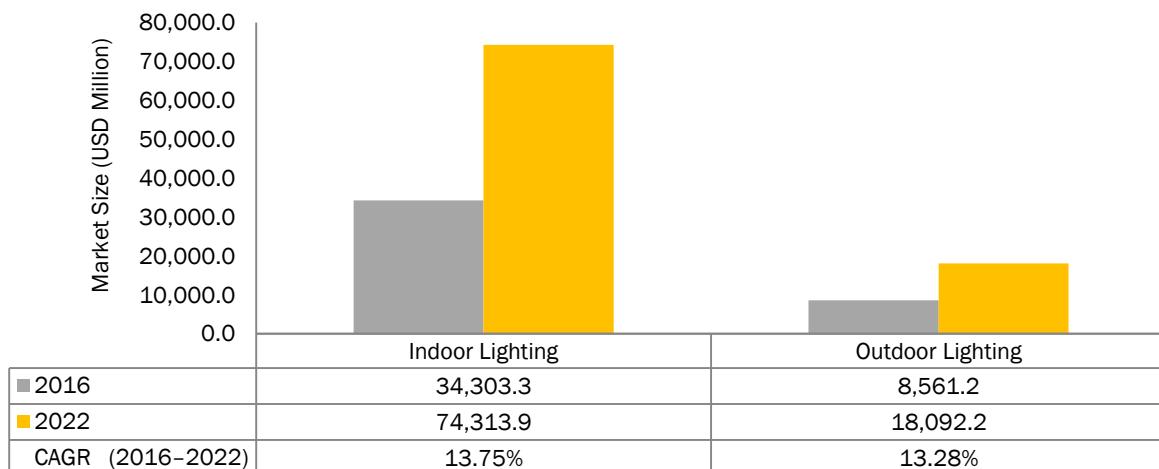
FIGURE 12 NEW INSTALLATION EXPECTED TO HOLD A LARGE MARKET SHARE DURING THE FORECAST PERIOD



Source: Investor Presentations, Annual Reports, Press Releases, Experts' Interviews, and MarketsandMarkets Analysis

4.3 LED LIGHTING MARKET, BY END-USE APPLICATION

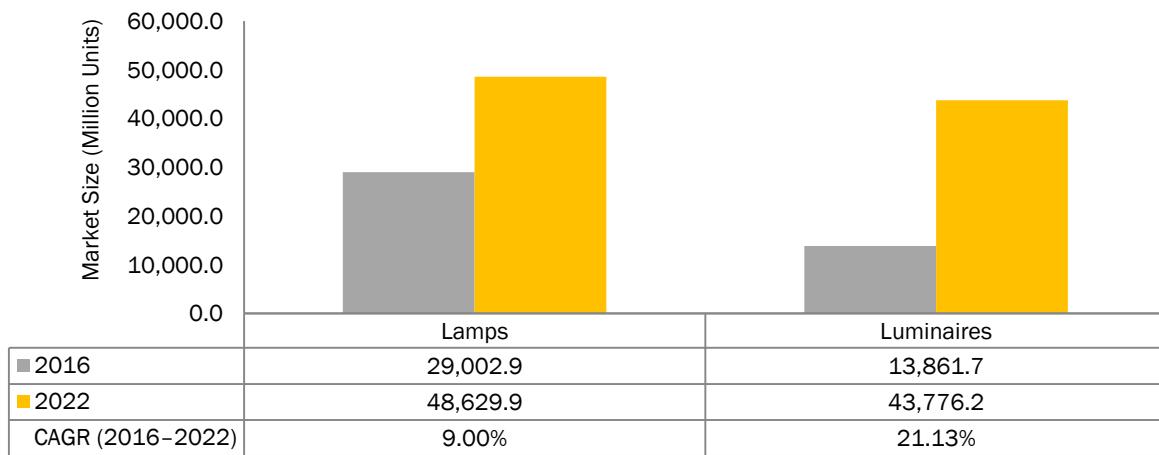
FIGURE 13 MARKET FOR INDOOR LIGHTING EXPECTED TO EXHIBIT HIGH GROWTH DURING THE FORECAST PERIOD



Source: Investor Presentations, Annual Reports, Press Releases, Experts' Interviews, and MarketsandMarkets Analysis

4.4 LED LIGHTING MARKET, BY PRODUCT TYPE

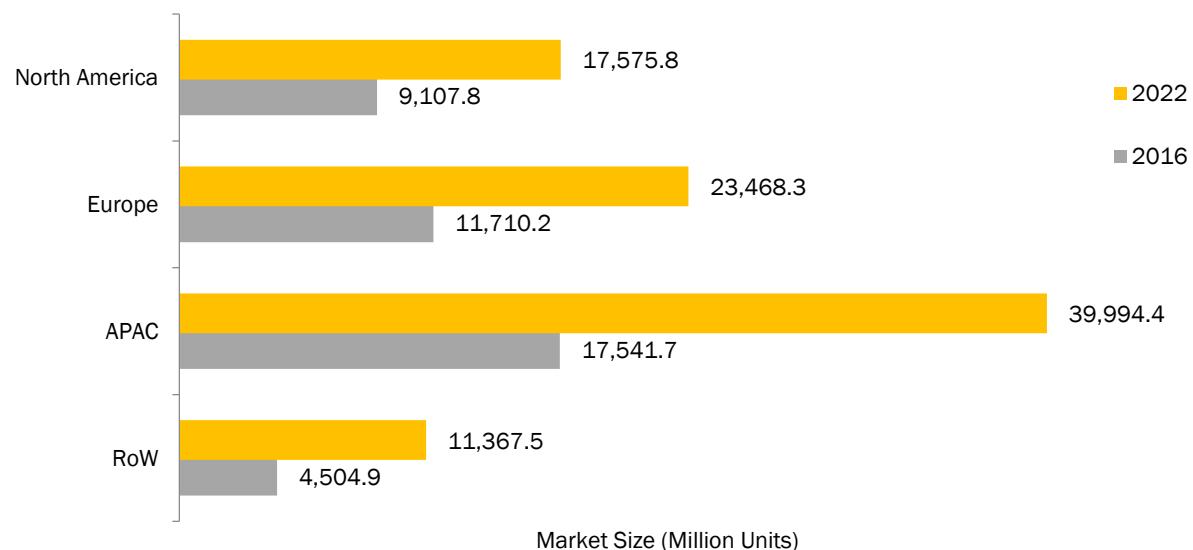
FIGURE 14 MARKET FOR LUMINAIRES EXPECTED TO GROW AT A HIGHER RATE DURING THE FORECAST PERIOD



Source: Investor Presentations, Annual Reports, Press Releases, Experts' Interviews, and MarketsandMarkets Analysis

4.5 LED LIGHTING MARKET, BY GEOGRAPHY

FIGURE 15 ASIA-PACIFIC EXPECTED TO DOMINATE THE LED LIGHTING MARKET DURING THE FORECAST PERIOD



Source: Investor Presentations, Annual Reports, Press Releases, Experts' Interviews, and MarketsandMarkets Analysis

5 MARKET OVERVIEW

KEY FINDINGS

- Increasing demand for energy-efficient lighting system is a major driver for the LED lighting market.
- Demand for LED lighting is being driven by the modernization and development of infrastructure such as smart cities.
- Government mandates on optimum energy consumption in most of the countries are supporting the growth of the LED lighting market.
- Lack of awareness regarding the payback period and installation expenses of LED lighting system is acting as a key restraint for the LED lighting market.
- The systems/solutions market in future can provide endless opportunities for the LED lighting market.
- Availability of common communication platform is a key challenge for the LED lighting market.

5.1 INTRODUCTION

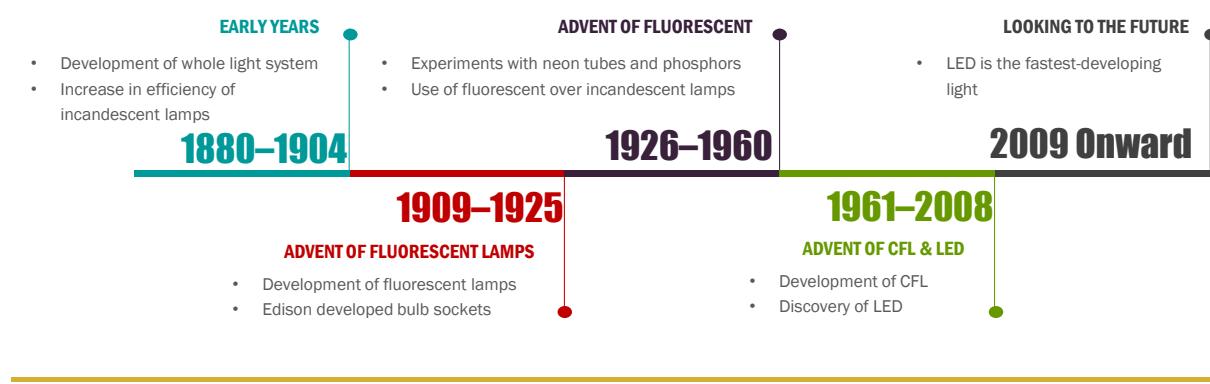
The market evolution section describes the way the LED lighting market has grown over the years. It includes the factors affecting the market dynamics such as drivers, restraints, opportunities, and challenges with respect to the LED lighting ecosystem.

5.2 MARKET EVOLUTION

The concept of LED lighting came up with the use of automatic light dimming that serves to reduce energy consumption and the invention of LED bulbs.

Compared with incandescent lamps, LED lamps are several times electrically efficient and have a longer lifespan. They are also significantly more efficient than fluorescent lamps, and unlike fluorescent lamps, LEDs do not require warm-up time to come to full brightness.

FIGURE 16 EVOLUTION OF LIGHT AND LED LIGHTING



Source: White Papers, Experts' Interviews, Industry Journals, and MarketsandMarkets Analysis

Prominent developments were observed in incandescent lighting between 1882 and 1920. The first lamp to use halogen gas (chlorine) was patented in 1882; however, the first commercial halogen lamp that used iodine as a halogen gas was patented in 1959 by General Electric. Thomas Edison focused on the entire lighting system showing that it was possible to distribute electricity from a centrally located generator in London and developing the first commercial power utility in Manhattan. In 1904, incandescent lamps with tungsten filaments were introduced in the European market. These bulbs lasted longer and were brighter and more efficient than lamps with carbon filaments. In 1909, Edison developed bulb sockets, and it is now used for almost all residential lighting applications.

Prominent developments were observed in fluorescent lighting between 1926 and 1960. In the late 1920s and early 1930s, European researchers experimented with neon tubes coated with phosphors. These experiments helped spark fluorescent lamp research in the U.S. In 1939, GE and Westinghouse introduced fluorescent lamps in San Francisco. By 1951, more light in the U.S. was being produced by linear fluorescent lamps than incandescent lamps. This change was led by the need for efficient lighting during the World War II.

Prominent developments were observed in fluorescent and LED lighting technology between 1961 and 2000. In 1962, the first light-emitting diode that emitted light in the visible part of the frequency range was developed by Nick Holonyak Jr. of the General Electric Company. The 1973 oil crisis marked a turning point in the U.S. energy consumption. Consequently, researchers began developing fluorescent bulbs for residential use. In 1974, researchers at Sylvania started investigating how they could miniaturize the ballast and tuck it into the lamp. In 1976, Edward Hammer at General Electric created the first spiral-shaped compact fluorescent lamp (CFL). Early CFLs hit the market in the mid-1980s and their prices ranged between USD 25 and USD 35 a bulb. The invention of the blue diode in the 1990s quickly led to

the discovery of white LEDs. Shortly thereafter, researchers demonstrated white light using red, green, and blue LEDs. Initially, many CFLs were big and bulky and did not fit well into fixtures. They had low light output and inconsistent performance. Since then, improvements in CFL performance, price, efficiency, and lifetime have made them a viable option for residential use.

In 2000, the U.S. Department of Energy partnered with private industries to push white LED technology forward by creating a high-efficiency packaged LED device. By 2008, there were few LED replacement bulbs in the market and most were in the range between 25 and 40 watt. In late 2009, Philips Lighting North America introduced its LED bulb in the lighting market and named it L Prize 60-watt.

Since 2008, the cost of LED bulbs has fallen by more than 85%, and in 2015, a number of retailers announced that they would sell LEDs at USD 10.

LED is one of the fastest-developing lighting technologies. It is a type of solid-state lighting. LEDs use a semiconductor to convert electricity into light and emit light in a specific direction, reducing the need for reflectors and diffusers that can trap light. Lighting manufacturers continue to make improvements in the quality of light and the energy efficiency of LEDs while cutting their cost. Today's LED bulbs are six to seven times more energy efficient than conventional incandescent lights. LED bulbs can last more than 25 times longer than conventional incandescent lights and increase efficiency by more than 80%. These advancements have led to rapid deployment of these bulbs in commercial and residential applications in the past couple of years. In 2012, more than 49 million LEDs were installed in the U.S., which is saving about USD 675 million of annual energy costs. As prices continue to drop, LEDs are expected to become a common feature in homes across the country.

5.3 MARKET SEGMENTATION

The LED lighting market has gained an important place in the global market in the past few years owing to increasing customer demands for energy-efficient and cost-effective LEDs. The overall LED lighting market has been classified into four major segments, namely, installation type, product type, end-use application, and geography. Each segment has been further classified into various subsegments.

5.3.1 BY INSTALLATION TYPE

On the basis of installation type, the LED lighting market has been categorized into new installation and retrofit lamps.

TABLE 1 LED LIGHTING MARKET, BY INSTALLATION TYPE

Installation Type	Description
New Installation	New installation refers to installation of completely new fixtures and LED lamps in place of old generation lamps and fixtures.
Retrofit Installation	It refers to the replacing of old incandescent lamps with LED lamps on the existing fixtures with slight alterations.

Source: Experts' Interviews and MarketsandMarkets Analysis

5.3.2 BY PRODUCT TYPE

The LED lighting market on the basis of product type has been segmented into lamps and luminaires.

TABLE 2 LED LIGHTING MARKET, BY PRODUCT TYPE

Product Type	Description
Lamps	Lamps refer to LED light sources or an LED lamp that gives off light in the visible spectrum.
Luminaires	A luminaire or light fixture is an electrical device used to create artificial light by using an electric lamp. All light fixtures have a fixture body and a light socket to hold the lamp and allow for its replacement. Fixtures may also have a switch to control the light.

Source: Experts' Interviews and MarketsandMarkets Analysis

5.3.3 BY END-USE APPLICATION

The LED lighting market on the basis of end-use application has been segmented into indoor lighting and outdoor lighting.

TABLE 3 LED LIGHTING MARKET, BY END-USE APPLICATION

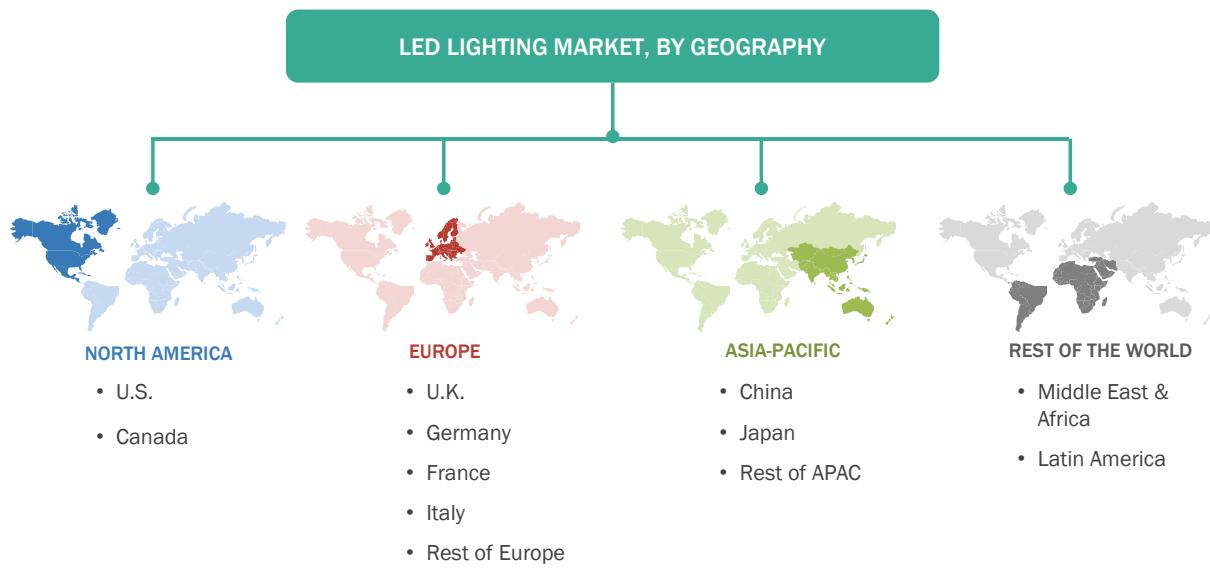
End-Use Application	Description
Indoor Lighting	Indoor lighting includes lighting for residential, commercial, industrial, and other applications.
Outdoor Lighting	Outdoor lighting includes various street lighting, architectural lighting, and public place lighting.

Source: Experts' Interviews and MarketsandMarkets Analysis

5.3.4 BY GEOGRAPHY

The LED lighting market has been broadly segmented into four major geographic regions, namely, North America, Europe, Asia-Pacific (APAC), and Rest of the World (RoW).

FIGURE 17 LED LIGHTING MARKET, BY GEOGRAPHY



Note 1: Rest of Europe includes other European countries such as Spain, Netherlands, Belgium, Russia, East European countries, and Nordic countries.

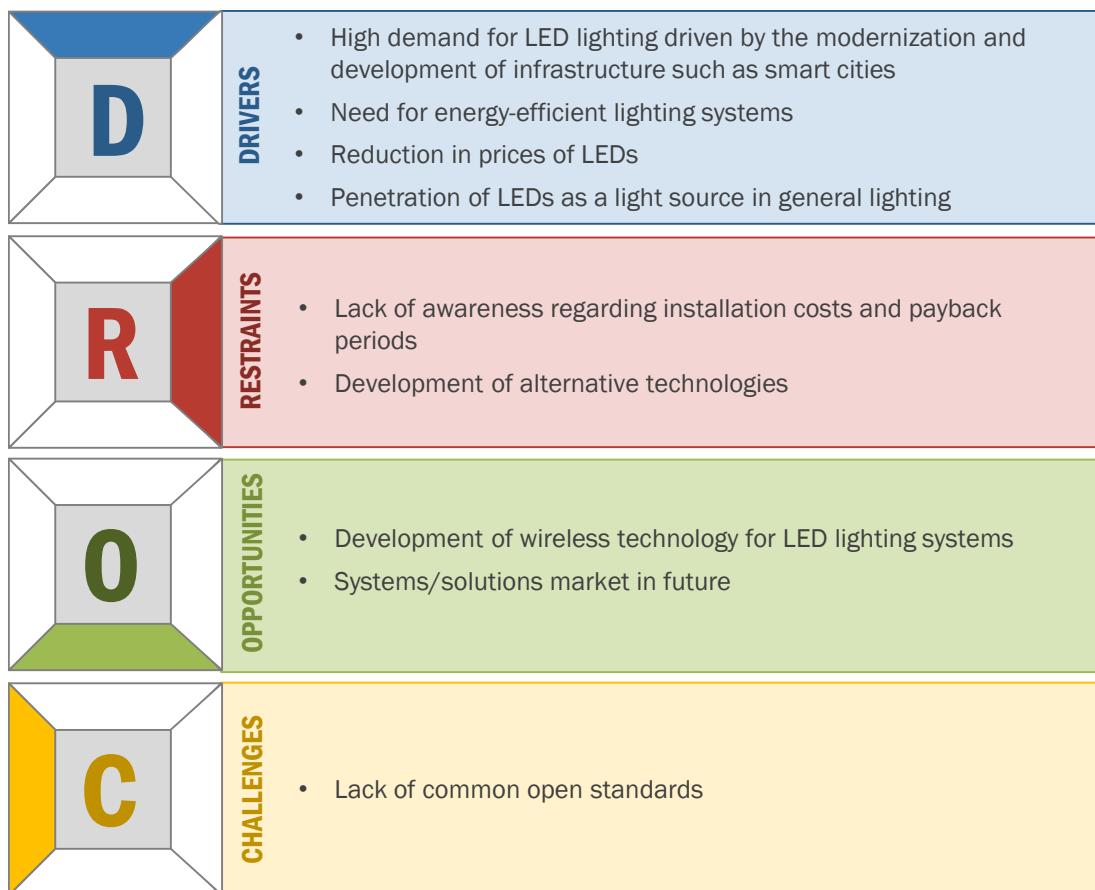
Note 2: Rest of APAC includes India, South Korea, Australia, Taiwan, and Philippines.

Source: Experts' Interviews, Secondary Research, and MarketsandMarkets Analysis

5.4 MARKET DYNAMICS

This section elaborates on the factors affecting the market dynamics, namely, drivers, restraints, opportunities, and challenges, analyzing and listing several factors that positively influence and negatively affect the individual submarkets considered in this study.

FIGURE 18 MARKET DYNAMICS: OVERVIEW



Source: Business Journal, White Papers, Experts' Interviews, and MarketsandMarkets Analysis

5.4.1 DRIVERS

5.4.1.1 High demand for LED lighting driven by the modernization and development of infrastructure such as smart cities

The application area of LED lighting is extending to warehouses, residential and commercial facilities, government buildings, and other areas. Electricity is majorly used in lighting streets and public spaces, cities, towns, and villages across the world. Today, a paradigm shift from traditional lighting systems to connected LED technology is the key to energy and cost saving in all lighting applications. LED bulbs are well known for their energy efficiency. These bulbs reduce the electric power required to generate a fixed amount of light and have the additional benefit of long life span which reduces maintenance and replacement costs. For instance, government officials in cities across the U.S. are focused on the latest innovations in lighting as they see an opportunity to do a lot more than simply illuminate an area. The smart lights are capable of communicating wirelessly to various networks, collecting various types of data such as nearby foot traffic and even helping to reduce crime rates, which traditional lightbulbs cannot do. The LED lighting system is gaining huge support and promotion from emerging countries as it forms part of their economy modernization plan.

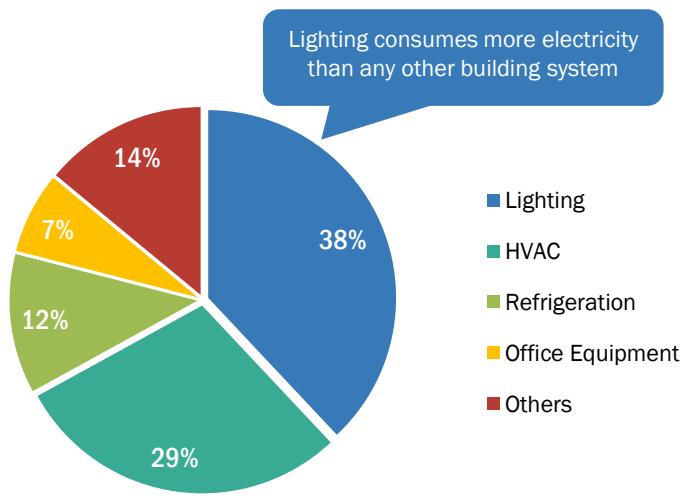
5.4.1.2 Need for energy-efficient lighting systems

The increasing price of energy is one of the major reasons behind the growing usage of LED lighting. Governments in countries such as Thailand, China, Brazil, and U.S. have implemented stringent regulations mandating the use of LED lighting and forcing fixture manufacturers to comply with minimum standards of lighting efficiency. Moreover, the use of incandescent lighting products is banned in many countries such as U.S., Russia, Brazil, Argentina, Canada, and Australia to ensure energy efficiency and to reduce the carbon footprint. This has encouraged construction enterprises to deploy LED lighting systems complying with regulations laid down by governments across nations, thereby fueling the demand from the global market for LED lighting products and solutions. The requirement of energy is also increasing because of rapidly increasing industrialization in Asia-Pacific. LED lighting provides high-efficiency fixtures and automated controls that make modifications based on conditions such as occupancy or daylight availability.

In Anchorage, new LED streetlights draw 50% less energy than existing luminaires, saving USD 360,000 a year. The city's 15,700 replacement lamps are expected to save USD 1.7 million annually.

LED lighting has a good hold in certain applications such as street lighting where it can absorb the initial cost in the short term and achieve benefits in the long term. Companies such as OSRAM AG (Germany) manufacture systems that allow keeping the entire street lighting under control via software.

FIGURE 19 U.S. ANNUAL ENERGY CONSUMPTION IN COMMERCIAL BUILDINGS, 2011



Note: Others include elevators, fire and smoke alarms, and biometric security systems, among others.

Source: U.S. Environmental Protection Agency

The above figure indicates that average lighting consumes maximum electricity in commercial buildings annually. According to the Executive Order 13423 of the U.S. Environmental Protection Agency, all government facilities must achieve a 30% total energy reduction from their 2003 baseline by 2020. Therefore, the LED lighting system has a wider scope in implementing the energy reduction strategy of the government. LED lighting systems allow to save energy. Commercial buildings and industrial plants together account for roughly 50% of the total energy consumption in the U.S., translating to approximately USD 400 billion of energy cost. Devices such as smart meters can reduce the power consumption and CO₂ emissions by up to 5%.

In countries such as the U.S. where 65% of the energy is being consumed by commercial and industrial sectors and 22% by lighting alone, there is a tremendous opportunity for saving energy. The connected lighting controls have the edge over conventional lighting switching systems as in the absence of any person they can automatically switch off the light to save power. Thus, the major advantage of lighting

controls is that they reduce the energy consumption and therefore the electricity bills. Hence, the demand for energy-efficient systems is expected to have a high impact on the demand for LED lighting globally.

5.4.1.3 Reduction in prices of LEDs

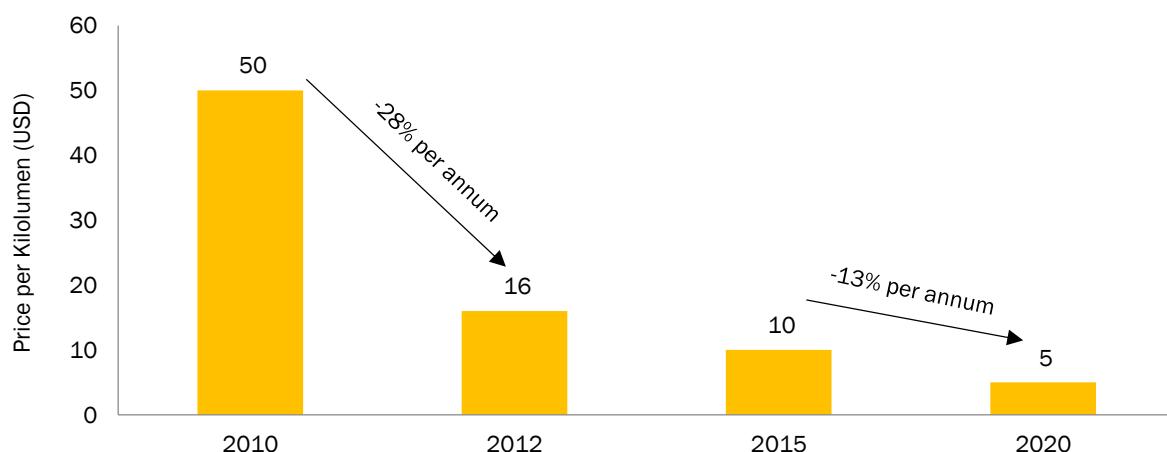
According to the findings of the U.S. Department of Energy's (DOE) 2011 Solid-State Lighting Manufacturing Roadmap, the prices of LED lamps by OEMs and LED packages are expected to drop by around 30% per annum from 2010 to 2015, and by 10–15% per annum from 2015 to 2020. This cost reduction is becoming increasingly visible every year owing to the strong focus of manufacturing companies in the LED lighting sector. The price of a warm-color LED package was USD 4 per kilolumen in 2009 and USD 3 per kilolumen in 2010, falling to USD 2 per kilolumen in the 2011 version of the DOE roadmap.

There are two main factors responsible for the reduction in prices of LED lights.

The first factor is improved luminous efficacy. Luminous efficacy is improving the brightness of light generated (measured in lumen) in terms of power consumed (measured in watt).

The second factor is low production costs of LEDs. Raw material costs for LED manufacturing are falling as the LED market is expanding due to economies of scale. The choice of material for LED production is also equally important. The most expensive component of LED raw material is the sapphire substrate. This substrate can be substituted by silicon (as in most other semiconductor applications) which can significantly reduce the cost. Downsizing the LED package and thus the entire light source (and potentially the fixture) also leads to reduction in material costs.

FIGURE 20 REDUCTION IN LED PRICES



Source: U.S. Department of Energy

5.4.1.4 Penetration of LEDs as a light source in general lighting

Penetration of LEDs in the general lighting industry is very low because LED is still expensive for high-brightness applications. Red, green, and blue LEDs are already well accepted in architectural lighting as they have clear benefits over traditional lighting, and this makes architectural lighting one of the earliest adopters of LED lights. Other LED lamps such as white LED lighting are also starting to grow. Also, as a result of substantial reductions in costs and the global awareness on energy conservation, the share of LEDs in the general lighting market is expected to rise between 2016 and 2020.

5.4.2 RESTRAINTS

5.4.2.1 Lack of awareness regarding installation costs and payback periods

Majority of the end users perceive that the cost of installing an LED lighting system is high due to the cost of the equipment as well as the cost of the integration and installation services. However, against this popular perception, the cost is primarily dependent on the complexity of integration pertaining to a specific application. The homeowners and corporate managers demand for cost-effective systems that also ensure energy savings but fail to realize the extent of the energy savings and the associated long-term cost savings. With lighting control systems, the lighting costs can be reduced by 30–60% while enhancing lighting quality and reducing environmental impact. This perception of high cost can hinder the deployment and growth of LED lighting at the global level. Efforts need to be taken by the manufacturers, facility managers, and governments to make customers aware about the long-term benefits of installing an LED lighting system.

5.4.2.2 Development of alternative technologies

The development of alternative lighting technologies such as laser lights can be viewed as a restraint for the LED lighting market. Laser lights have been proved to be more efficient than LEDs and almost as cost-effective in terms of manufacturing.

Applications of laser lights in entertainment displays and architectural lighting are already becoming popular, and it is one of the main reasons for LED application in architectural lighting to be stagnating.

5.4.3 OPPORTUNITIES

5.4.3.1 Development of wireless technology for LED lighting systems

The LED lighting market which initially started with wired technologies has entered the era of wireless technologies. The introduction of wireless technologies has boosted the market for retrofit lighting systems, leading to the growth of the LED lighting market. The wireless technologies have not only reduced the usage of wires but also helped to avoid the reconstruction of the existing buildings, thereby creating flexibility for end users.

Recently, developments have been taking place toward integrating wired and wireless technologies. BACnet has added wireless networking options by adding the ZigBee profile to the LED lighting system. ZigBee is a wireless technology designed to address the requirements of the low-cost, low-power wireless sensors and control networks in the LED lighting market. This integration between BACnet and ZigBee would allow to create an efficient and connected LED lighting system. Besides ZigBee, the other wireless communication technologies used in LED lighting systems are EnOcean, Z-Wave, and Wi-Fi. These wireless networks offer one of the biggest opportunities in the connected lighting market, especially in the areas of the retrofit market.

5.4.3.2 Systems/solutions market in future

The systems/solutions sector is expected to be a large market in the future as new solutions would be created for every application owing to the advent of LED lights. Some of the possible key players could be the companies involved in building solutions. Many lighting companies, especially those involved in making fixtures, are now targeting this sector as it has the potential to be one of the largest untapped opportunities in the lighting industry. Many building solutions companies are also targeting the lighting systems business as part of their overall building solutions business.

5.4.4 CHALLENGES

5.4.4.1 Lack of common open standards

The setting up of a general lighting standardization for LEDs has been initiated by several organizations such as the Zhaga Consortium. The lack of common open standards is creating inefficiency in the industry. For example, manufacturers of an LED module/light engine cannot benefit from the economies of scale, and designers and manufacturers of fixtures and module/light engines cannot design their products smoothly due to the lack of extensive coordination among various parts suppliers.

LED lighting system manufacturers are focusing on the development of open protocol devices with BACnet or LonMark interoperability, as these two are among the only open standard protocols for communication in LED lighting system. However, in the new world of convergence, systems that assert to offer interoperability and match the industry standards must also provide connectivity to various other equipment that integrate seamlessly into the network. BACnet or LonMark alone cannot ensure a total enterprise information compatibility and interoperability.

6 INDUSTRY TRENDS

6.1 INTRODUCTION

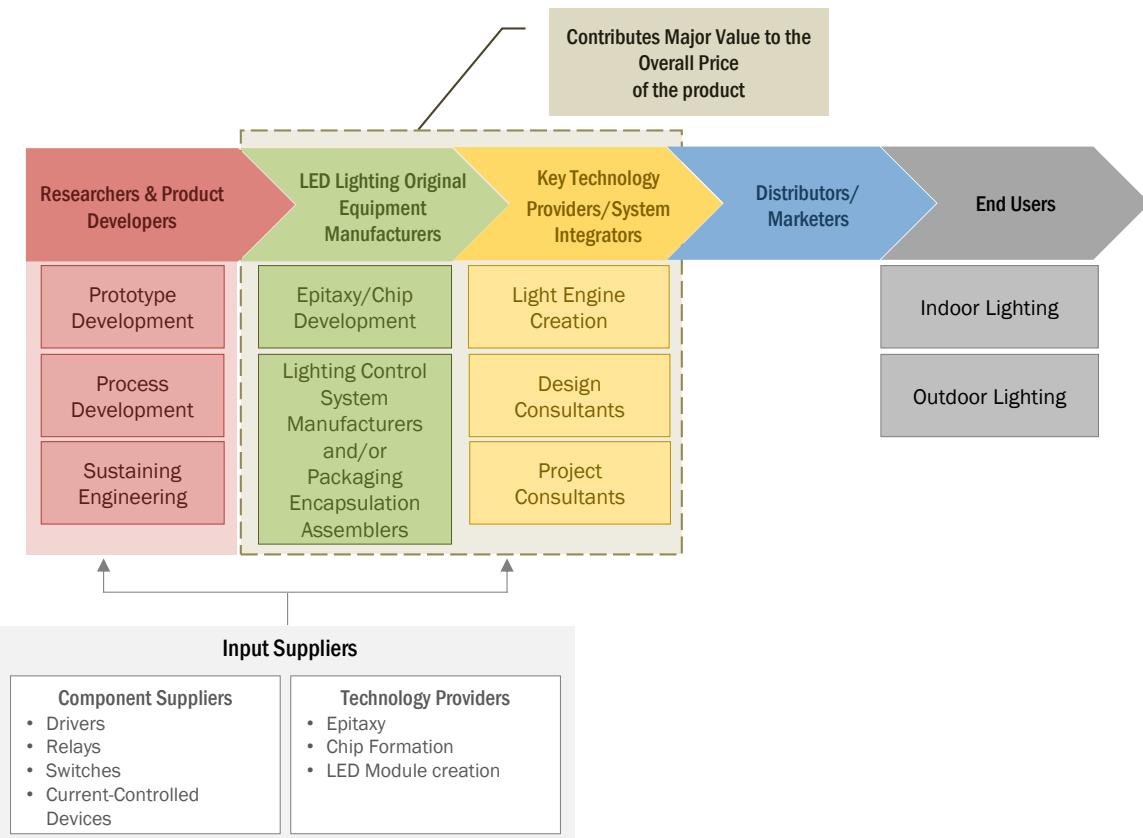
The chapter covers the value chain analysis of the LED lighting market. It also includes an analysis of the market with respect to Porter's five forces model.

The concept of LED lighting technology has evolved significantly over the last decade. This concept of having energy efficiency in lighting systems is highly technology oriented and ensures long life for lighting systems. Conventional lighting systems have not been restricted by cost and complexity, but they are not as energy efficient, nor do they have a long life. A shift from traditional incandescent lighting systems to LED lighting provides greater benefits, at a lower maintenance cost, to a much wider set of potential customers.

6.2 VALUE CHAIN ANALYSIS

The LED lighting market value chain comprises many entities from LED lighting component manufacturers to technology providers. Products and devices are distributed by specialized distributors that are into lighting and related fields. Some of the manufacturers that have a strong presence across the concerned geographic regions have a built-in distribution network. Distributors and manufacturers often establish partnerships with distributors across various regions having an expertise in products and services concerned with LED lighting because of the lack of knowledge of networking. These distributors are key points of contact for professional and custom installers. They consist of a strong network of system integrators which include custom system integrators, dealers, business models, and contractors.

FIGURE 21 LED LIGHTING MARKET: VALUE CHAIN ANALYSIS



Source: Lighting Controls Association (U.S.), National Electrical Manufacturers Association (NEMA, U.S.), Industry Journals, Experts' Interviews, and MarketsandMarkets Analysis

6.2.1 RESEARCH AND DEVELOPMENT

The research and product development is the first stage in the LED lighting market value chain and it takes place in the individual research institutes, universities, or at manufacturers' private research and development (R&D) facilities. The process starts with developing the prototype depending on the end-user requirements, testing the prototypes, getting regulatory approvals from the concerned governing bodies, and finally sustaining the engineering process for LED lighting systems. Some of the major stakeholders in R&D include Smart Lighting Engineering Research Center (Rensselaer Polytechnic Institute, U.S.), Boston University (U.S.), and University of New Mexico (New Mexico).

6.2.2 LED LIGHTING ORIGINAL EQUIPMENT MANUFACTURERS

In the second stage of the LED lighting market value chain, the prototype system developed and approved in the R&D stage is finally taken for further development. The lighting manufacturing companies use the approved prototypes to develop commercial lighting systems. This stage majorly involves creation of epitaxy wafers, chip packaging, and light engine modules. Notable players include Philips Lighting (Netherlands) and Acuity Brands Lighting, Inc. (U.S.). These players integrate their control systems with traditional lights to incorporate intelligent content in their products. The major manufacturers include Philips Lighting (Netherlands) and OSRAM Licht GmbH (Germany).

6.2.3 KEY TECHNOLOGY PROVIDERS/SYSTEM INTEGRATORS

The third stage includes technology providers that comprise design and project consultants and other service vendors. This stage also contributes maximum value to the overall value chain. These system integrators guide the LED lighting companies in commercial installations. These vendors provide light engines to OEMs for their LED lighting projects. The major companies in this stage are DimOnOff, Inc. (Canada), Samsung (South Korea), and Sharp Corporation (Japan).

6.2.4 DISTRIBUTORS/MARKETERS

The next step in the LED lighting market value chain is sales and marketing of the developed products. In this stage, the companies target various end users such as government organizations, commercial end users, residential building owners, educational institutions through direct sales, local distributors, and lighting vendors.

6.3 KEY INDUSTRY TRENDS

FIGURE 22 GREATER VERTICAL INTEGRATION—LEADING TREND AMONG KEY MARKET PLAYERS

KEY TREND	DESCRIPTION
Growing Connectivity and Closed Communication Protocols	<ul style="list-style-type: none"> There has been considerable growth in the number of new installations in the LED lighting market in the past five years. Players in this market are focused on establishing standards to gain a competitive advantage in the marketplace.
Greater Vertical Integration Among Lighting Players	<ul style="list-style-type: none"> In the past few years, manufacturers have put an increasing emphasis on greater vertical integration, focusing particularly on packaging, modules, and other lighting technologies. The growing vertical integration has offered many opportunities to lighting manufacturers to diversify and move downstream to ensure their competitive advantage.

Source: Lighting Controls Association (U.S.), National Electrical Manufacturers Association (NEMA, U.S.), Industry Journals, Experts' Interviews, and MarketsandMarkets Analysis

6.4 PORTER'S FIVE FORCES ANALYSIS

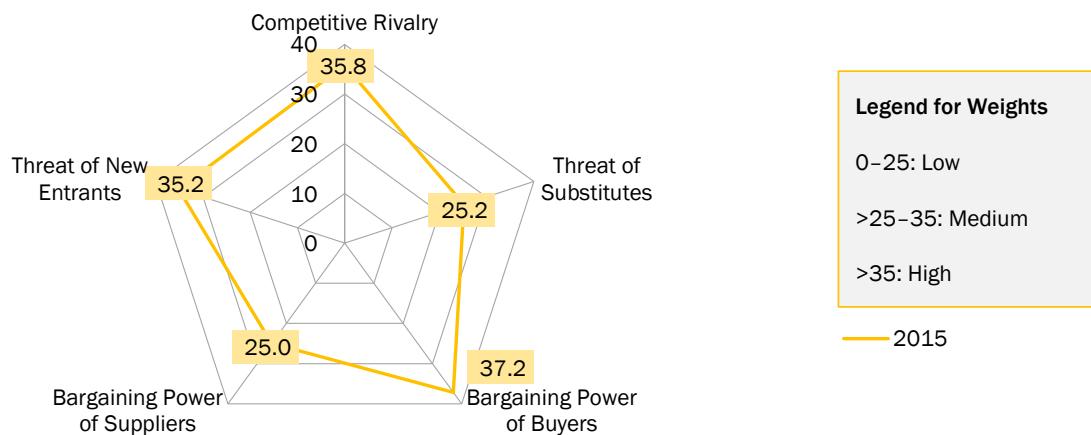
Porter's five forces model determines the current scenario of the LED lighting market. It guides companies in making decisions regarding entering or exiting a particular segment or the entire industry. Changes in these forces can have a major impact on the market. Porter's five forces analyze the LED lighting market from five different perspectives, namely, the intensity of rivalry or degree of competition within the industry, threat of new entrants, bargaining power of suppliers, bargaining power of buyers, and threat of substitutes.

The competitive environment in the industry can be analyzed through Porter's five forces analytical framework, which is based on the concept that there are five forces that determine the competitive intensity and growth potential of a market. Porter's five forces model helps to identify where the power lies in a business scenario. These five forces have been discussed in detail in the following section.

FIGURE 23 PORTER'S FIVE FORCES ANALYSIS



Source: Lighting Controls Association (U.S.), National Electrical Manufacturers Association (NEMA, U.S.), Industry Journals, Experts' Interviews, and MarketsandMarkets Analysis

FIGURE 24 PORTER'S FIVE FORCES: IMPACT ANALYSIS

Source: Lighting Controls Association (U.S.), National Electrical Manufacturers Association (NEMA, U.S.), Industry Journals, Experts' Interviews, and MarketsandMarkets Analysis

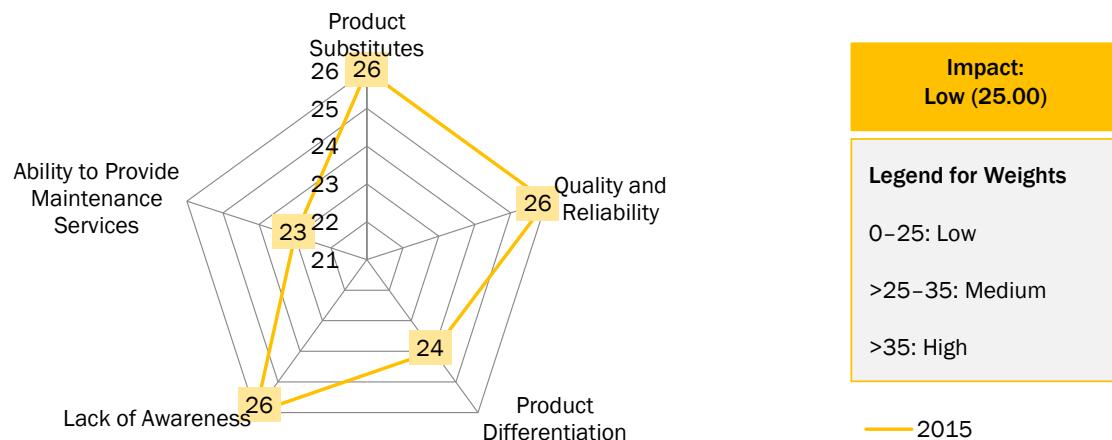
The above figure indicates that buyers' bargaining power and competitive rivalry in the market are the dominant forces that are expected to have a high impact on the current market. The low impact of suppliers' bargaining power can be attributed to the fact that the market is highly fragmented with a large number of product manufacturers, component providers, distributors, and systems integrators. The impact of the threat of new entrants has been analyzed to be high in the current market as there is a wide scope for expansion across emerging geographies.

The threat of substitutes has also been analyzed. LED lighting technology is promoted by government authorities. LEDs have fewer cost benefits than traditional lights; however, in the long-term use, LED lights are found to be beneficial. Therefore, the overall impact of this force on the market has been analyzed to be medium.

6.4.1 BARGAINING POWER OF SUPPLIERS

The bargaining power of the supplier assesses how easy it is for the suppliers to drive the prices of the equipment in the LED lighting market.

FIGURE 25 BARGAINING POWER OF SUPPLIERS IN THE LED LIGHTING MARKET, 2015



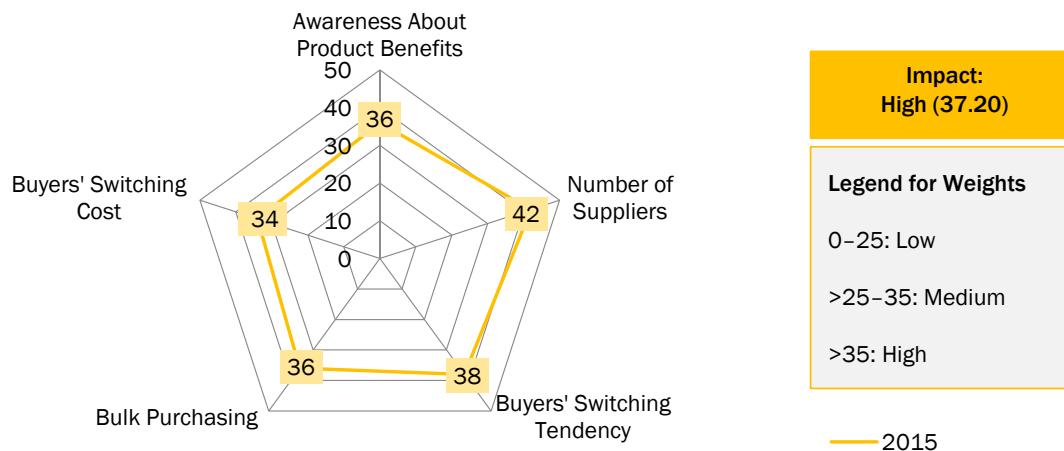
Source: Lighting Controls Association (U.S.), National Electrical Manufacturers Association (NEMA, U.S.), Industry Journals, Experts' Interviews, and MarketsandMarkets Analysis

The major challenge for suppliers in this market is the end users' lack of knowledge about the long-term benefits of LED lighting solutions. Taking these factors into consideration, companies need to focus more on sales and promotional activities to gain a significant share of the market as well as improve consumer awareness. In addition, the number of product substitutes in this market is medium such as normal LEDs or other similar energy-saving lighting systems without smart features. Therefore, the bargaining power of suppliers in the LED lighting market has been analyzed to have a low impact.

6.4.2 BARGAINING POWER OF BUYERS

The bargaining power of buyers assesses the ease with which buyers reduce prices in the LED lighting market.

FIGURE 26 BARGAINING POWER OF BUYERS IN THE LED LIGHTING MARKET, 2015



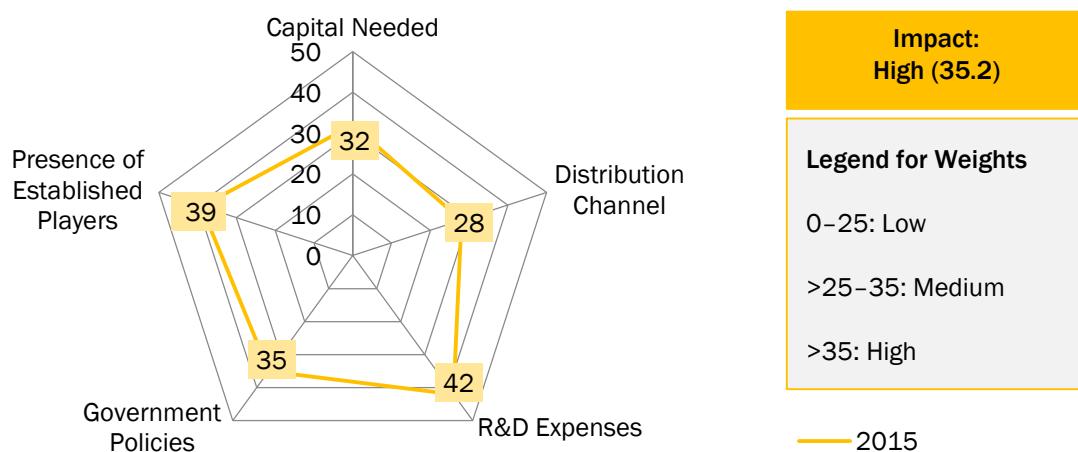
Source: Lighting Controls Association (U.S.), National Electrical Manufacturers Association (NEMA, U.S.), Industry Journals, Experts' Interviews, and MarketsandMarkets Analysis

Different types of LED lighting products are available in the market depending on their mode of application and end users. The customers are in a powerful position because of the presence of large number of suppliers as they can take a decision based on return on investments for deploying LED lighting solutions. Therefore, the suppliers need to reach out to customers through sales and promotional activities to sell their LED lighting products and also influence their switching tendency. It can therefore be concluded that the bargaining power of buyers has been analyzed to be high in this market.

6.4.3 THREAT OF NEW ENTRANTS

The threat of new entrants is a measure of the market situation that can affect the ability of a new entrant to enter into the LED lighting market.

FIGURE 27 THREAT OF NEW ENTRANTS IN THE LED LIGHTING MARKET, 2015



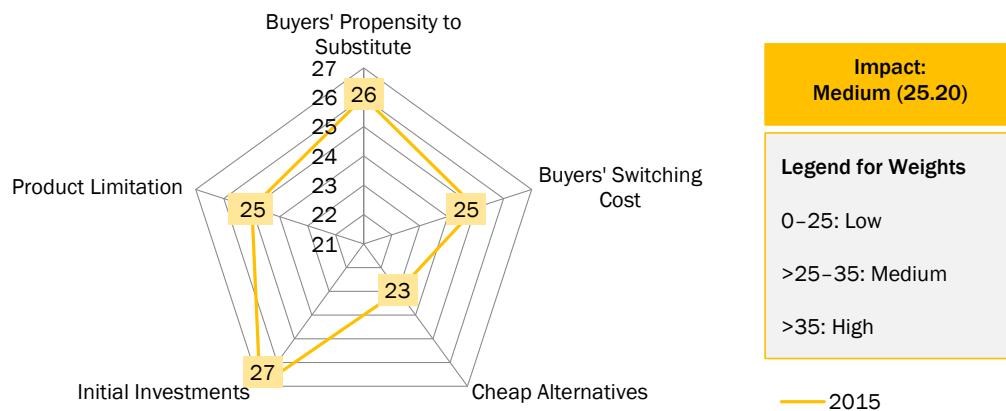
Source: Lighting Controls Association (U.S.), National Electrical Manufacturers Association (NEMA, U.S.), Industry Journals, Experts' Interviews, and MarketsandMarkets Analysis

The rapidly growing market and frequent technological advancements in the LED lighting market are attracting new players to enter this market. LED lighting is a fragmented market, and there is also a lack of standardization for LED lighting solutions. Different technologies based on LED lighting are easily available in the market. These factors favor the entry of new players. Moreover, the entry barriers are less as there is no stringent government law or policy that prevents new players from making an entry. However, the presence of lighting giants such as Philips (Netherlands), OSRAM GmbH (Germany), GE Lighting (U.S.), and others acts as a huge restraint for new entrants. It can be inferred that the threat of new entrants would be slightly high in this market considering all the above-stated factors.

6.4.4 THREAT OF SUBSTITUTES

The threat of substitutes arises when the customers or buyers in the market can achieve the desired end result by using other products.

FIGURE 28 THREAT OF SUBSTITUTES IN THE LED LIGHTING MARKET, 2015



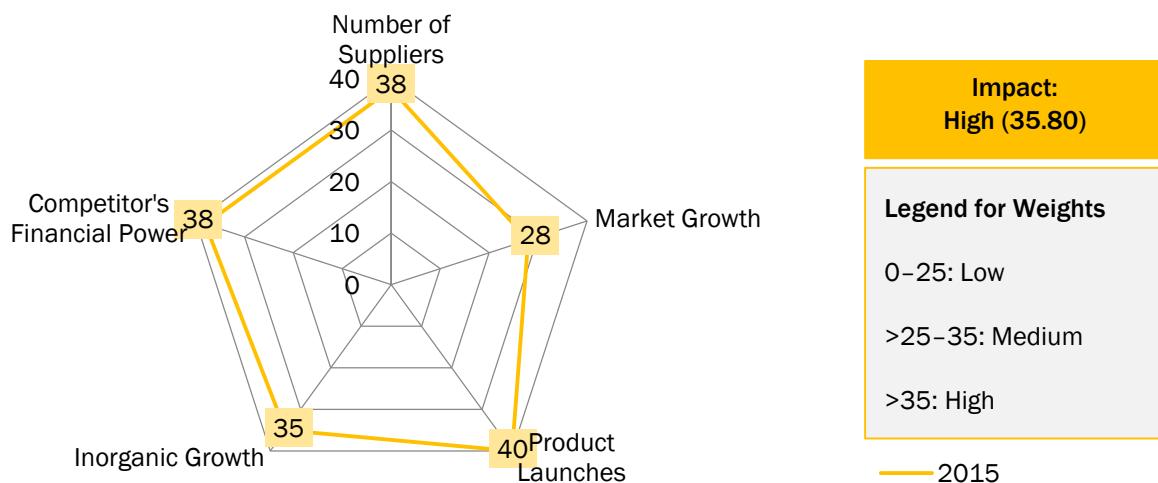
Source: Lighting Controls Association (U.S.), National Electrical Manufacturers Association (NEMA, U.S.), Industry Journals, Experts' Interviews, and MarketsandMarkets Analysis

The traditional lighting alternatives act as substitutes for LED lighting solutions. These products are affordable as well as simple to use. The nonconventional form of energy (solar), that is, solar lighting devices, may also be regarded as a substitute; however, they are mainly used for outdoor lighting applications. The main purpose of LED lighting is energy efficiency and longevity as none of the traditional lighting alternatives (or substitutes) offers such features; hence, they are not a threat to the LED lighting market. High initial investments are required for switching from traditional to LED lighting; hence, buyers' switching cost is critical. Individual buyers may not find it cost-effective initially. Therefore, the current impact of the threat of substitutes has been analyzed to be medium.

6.4.5 COMPETITIVE RIVALRY

The competitive rivalry assesses the market players' capability and level of rivalry among them in the LED lighting market.

FIGURE 29 COMPETITIVE RIVALRY IN THE LED LIGHTING MARKET, 2015



Source: Lighting Controls Association (U.S.), National Electrical Manufacturers Association (NEMA, U.S.), Industry Journals, Experts' Interviews, and MarketsandMarkets Analysis

There are established players in the market that manufacture end products such as luminaires, bulbs, control systems, and Internet-enabled devices. All these companies compete fiercely with each other. In the present scenario, many companies are launching new products in the market. It can be observed that LED products based on wireless technology are being launched on a large scale. The established players are using inorganic growth strategies by signing contracts with governments and public authorities, thereby giving tough competition to other players. Moreover, many new players are entering the LED lighting market as the entry barriers are low. For example, the LED lighting market in the U.S. is being dominated by start-up companies that are just three years old. Therefore, the degree of competition has been analyzed to be high in this market.

7 LED LIGHTING MARKET, BY INSTALLATION TYPE

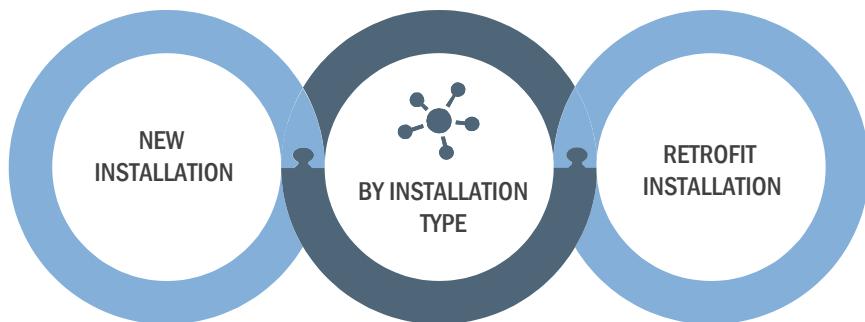
KEY FINDINGS

- The LED lighting market for new installation was valued at USD 27.59 billion in 2015 and is expected to reach USD 58.47 billion by 2022, growing at a CAGR of 10.78% during the forecast period.
- The new installation segment registered the highest shipment of 2.11 billion units in 2015 and is expected to reach 6.08 billion units by 2022, at a CAGR of 15.87% during the forecast period.
- The LED lighting market for luminaires (new installation) is expected to be valued at USD 16.90 billion by 2022, growing at the highest CAGR of 16.01% during the forecast period.
- The LED lighting market in RoW (new installation) is expected to be valued at USD 7.31 billion by 2022, growing at the highest CAGR of 12.96% during the forecast period.
- The market for the residential application (retrofit installation) was valued at USD 4.33 billion in 2015 and is expected to reach USD 14.36 billion by 2022, growing at a CAGR of 18.30% during the forecast period.

7.1 INTRODUCTION

This section provides the description of types of installations that are mainly used in LED lighting. The LED lighting market based on installation type has been segmented into new installation and retrofit installation.

FIGURE 30 LED LIGHTING MARKET, BY INSTALLATION TYPE



Note: Retrofit lamps include replacement lamps such as A-lamps, T-lamps, reflectors, and others such as low/high-bay and decorative lamps.

Source: Industry Journals, Experts' Interviews, and MarketsandMarkets Analysis

TABLE 4 LED LIGHTING MARKET, BY INSTALLATION TYPE, 2013–2022 (USD MILLION)

Installation Type	2013	2014	2015	2016	2018	2020	2022	CAGR (2016–2022)
New Installation	19,595.2	23,587.1	27,592.4	31,636.8	39,958.7	48,809.4	58,476.7	10.78%
Retrofit Installation	5,626.9	7,312.5	9,159.5	11,227.8	16,345.0	23,500.4	33,929.4	20.24%
Total	25,222.1	30,899.5	36,751.9	42,864.5	56,303.7	72,309.8	92,406.1	13.66%

Source: Experts' Interviews, Secondary Research, and MarketsandMarkets Analysis

The LED lighting market based on installation type was valued at USD 36,751.9 million in 2015 and is expected to reach USD 92,406.1 million by 2022, growing at a CAGR of 13.66% during the forecast period. The market for new installation was valued at USD 27,592.4 million in 2015 and is expected to reach USD 58,476.7 million by 2022, growing at a CAGR of 10.78% during the forecast period. The market for retrofit installation is expected to be valued at USD 33,929.4 million by 2022, growing at the highest CAGR of 20.24% during the forecast period. Increasing replacement of incandescent lamps with energy-efficient light sources such as LED lamps is the major factor contributing to the growth of the market for retrofit installation. The old generation lamps are being slowly phased out and the fixtures are being retrofitted with LED lamps as they offer a longer working life and also consume less energy.

TABLE 5 LED LIGHTING MARKET, BY INSTALLATION TYPE, 2013–2022 (MILLION UNITS)

Installation Type	2013	2014	2015	2016	2018	2020	2022	CAGR (2016–2022)
New Installation	1,392.9	1,739.0	2,111.4	2,515.5	3,446.2	4,601.9	6,088.2	15.87%
Retrofit Installation	845.0	1,139.6	1,484.9	1,898.3	3,032.6	4,851.7	7,925.6	26.89%
Total	2,237.9	2,878.6	3,596.3	4,413.9	6,478.9	9,453.7	14,013.8	21.23%

Source: Experts' Interviews, Secondary Research, and MarketsandMarkets Analysis

The LED lighting market based on installation type registered a shipment of 3,596.3 million units in 2015 and is expected to reach 14,013.8 million units by 2022, at a CAGR of 21.23% during the forecast period. The new installation segment registered the highest shipment of 2,111.4 million units in 2015 and is expected to reach 6,088.2 million units by 2022, at a CAGR of 15.87% during the forecast period. However, shipment for the retrofit installation segment is expected to reach 7,925.6 million units by 2022, at the highest CAGR of 26.89% during the forecast period. Retrofit installations are expected to overtake new installations in terms of shipment because more number of lamps of traditional lighting fixtures are being replaced with LED lamps than complete replacement of lamps and fixtures with new installations.

7.2 NEW INSTALLATION

New installation refers to installation of completely new LED lighting systems containing the new generation LED lamps and luminaires. Unlike retrofit installation, which refers to partial replacement of lighting systems, new installation completely replaces a traditional lighting system after fully phasing out the lamp and its assorted controls and fixtures with the LED lamp and its associated controls and fixtures.

TABLE 6 LED LIGHTING MARKET FOR NEW INSTALLATION, BY PRODUCT TYPE, 2013–2022 (USD MILLION)

Product Type	2013	2014	2015	2016	2018	2020	2022	CAGR (2016–2022)
Lamps	16,110.2	19,009.6	21,870.7	24,702.2	30,312.1	35,912.6	41,575.5	9.06%
Luminaires	3,485.0	4,577.5	5,721.7	6,934.6	9,646.6	12,896.8	16,901.2	16.01%
Total	19,595.2	23,587.1	27,592.4	31,636.8	39,958.7	48,809.4	58,476.7	10.78%

Source: Experts' Interviews, Secondary Research, and MarketsandMarkets Analysis

The LED lighting market for new installation based on product type was valued at USD 27,592.4 million in 2015 and is expected to reach USD 58,476.7 million by 2022, growing at a CAGR of 10.78% during the forecast period. The market for lamps was valued at USD 21,870.7 million in 2015 and is expected to reach USD 41,575.5 million by 2022, growing at a CAGR of 9.06% during the forecast period. The market for luminaires is expected to be valued at USD 16,901.2 million by 2022, growing at the highest CAGR of 16.01% during the forecast period. New installations of LED lighting would generate increasing demand for luminaires, and it is one of the reasons for its high growth.

TABLE 7 LED LIGHTING MARKET FOR NEW INSTALLATION, BY PRODUCT TYPE, 2013–2022 (MILLION UNITS)

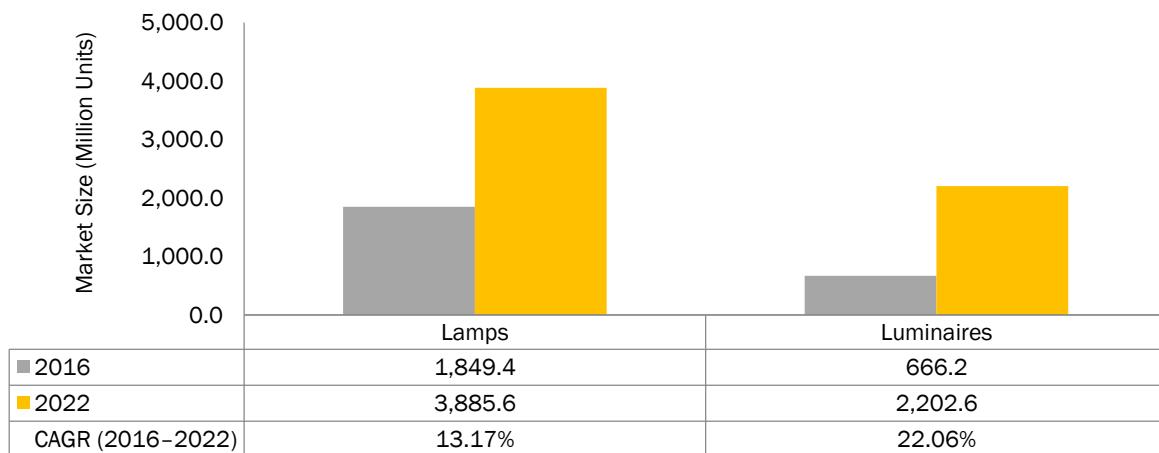
Product Type	2013	2014	2015	2016	2018	2020	2022	CAGR (2016–2022)
Lamps	1,097.0	1,334.7	1,584.8	1,849.4	2,430.5	3,099.7	3,885.6	13.17%
Luminaires	295.9	404.3	526.6	666.2	1,015.7	1,502.2	2,202.6	22.06%
Total	1,392.9	1,739.0	2,111.4	2,515.5	3,446.2	4,601.9	6,088.2	15.87%

Source: Experts' Interviews, Secondary Research, and MarketsandMarkets Analysis

The LED lighting market for new installation based on product type registered a shipment of 2,111.4 million units in 2015 and is expected to reach 6,088.2 million units by 2022, at a CAGR of 15.87% during the forecast period. The lamps segment registered the highest shipment of 1,584.8 million units in 2015 and is expected to reach 3,885.6 million units by 2022, at a CAGR of 13.17% during the forecast period. Lamps hold a larger size of the market than luminaires because multiple lamps can be controlled with

fewer number of luminaires. However, shipment for the luminaires segment is expected to reach 2,202.6 million units by 2022, at the highest CAGR of 22.06% during the forecast period.

FIGURE 31 LED LIGHTING MARKET FOR NEW INSTALLATION, BY PRODUCT TYPE (MILLION UNITS)



Source: Industry Journals, Experts' Interviews, and MarketsandMarkets Analysis

TABLE 8 NEW INSTALLATION LED LIGHTING MARKET FOR INDOOR LIGHTING, BY TYPE, 2013–2022 (USD MILLION)

Type	2013	2014	2015	2016	2018	2020	2022	CAGR (2016–2022)
Residential	8,175.4	9,728.4	11,248.4	12,745.6	15,714.0	18,722.8	21,863.0	9.41%
Commercial	6,232.3	7,527.0	8,834.6	10,163.5	12,923.7	15,893.2	19,170.7	11.16%
Industrial	503.7	617.0	734.1	855.9	1,116.4	1,406.6	1,736.1	12.51%
Others	163.4	223.5	293.0	372.2	562.2	800.0	1,095.1	19.71%
Total	15,074.8	18,095.8	21,110.1	24,137.2	30,316.2	36,822.6	43,864.9	10.47%

Note: Other indoor lighting applications include government and public buildings.

Source: Experts' Interviews, Secondary Research, and MarketsandMarkets Analysis

The LED lighting market for new installation based on the indoor lighting end-use application was valued at USD 21,110.1 million in 2015 and is expected to reach USD 43,864.9 million by 2022, growing at a CAGR of 10.47% during the forecast period. The market for the residential application was valued at USD 11,248.4 million in 2015 and is expected to reach USD 21,863.0 million by 2022, growing at a CAGR of 9.41% during the forecast period. Increase in global efforts in infrastructure improvement-related works, most of the buildings of which are for residential purposes, is a driving factor for the dominance of the residential sector. The market for other indoor lighting applications is expected to be valued at USD 1,095.1 million by 2022, growing at the highest CAGR of 19.71% during the forecast period.

TABLE 9 NEW INSTALLATION LED LIGHTING MARKET FOR OUTDOOR LIGHTING, BY TYPE,
2013–2022 (USD MILLION)

Type	2013	2014	2015	2016	2018	2020	2022	CAGR (2016–2022)
Highway & Roadway	1,804.2	2,217.1	2,646.5	3,094.8	4,060.8	5,144.9	6,384.1	12.83%
Architectural	2,513.1	3,023.4	3,535.1	4,051.7	5,114.4	6,245.1	7,481.5	10.76%
Public Places	140.4	175.6	213.2	253.3	342.4	445.5	566.3	14.35%
Others	62.7	75.1	87.4	99.8	124.9	151.3	179.9	10.32%
Total	4,520.4	5,491.2	6,482.2	7,499.6	9,642.5	11,986.8	14,611.8	11.76%

Note: Other outdoor lighting applications include rail lines and harbors.

Source: Experts' Interviews, Secondary Research, and MarketsandMarkets Analysis

The LED lighting market for new installation based on the outdoor lighting end-use application was valued at USD 6,482.2 million in 2015 and is expected to reach USD 14,611.8 million by 2022, growing at a CAGR of 11.76% during the forecast period. The market for architectural segment was valued at USD 3,535.1 million in 2015 and is expected to reach USD 7,481.5 million by 2022, growing at a CAGR of 10.76% during the forecast period. Architectural lighting is one of the early adopters of LED lamps. The advantage that LED offers in architectural lighting is RGB color controllability which is absent in traditional lamps that have to use color film filters and this leads to high maintenance costs. The market for public places segment is expected to be valued at USD 566.3 million by 2022, growing at the highest CAGR of 14.35% during the forecast period.

TABLE 10 LED LIGHTING MARKET FOR NEW INSTALLATION, BY REGION, 2013–2022 (USD MILLION)

Region	2013	2014	2015	2016	2018	2020	2022	CAGR (2016–2022)
North America	3,896.8	4,661.8	5,405.1	6,084.1	7,263.1	8,388.9	9,648.1	7.99%
Europe	5,030.8	6,044.2	7,028.3	7,946.2	9,764.4	11,523.0	13,575.5	9.34%
Asia-Pacific	8,717.7	10,436.7	12,323.8	14,087.5	18,318.8	23,179.6	27,942.8	12.09%
RoW	1,949.9	2,444.4	2,835.3	3,519.1	4,612.4	5,717.9	7,310.3	12.96%
Total	19,595.2	23,587.1	27,592.4	31,636.8	39,958.7	48,809.4	58,476.7	10.78%

Source: Experts' Interviews, Secondary Research, and MarketsandMarkets Analysis

The LED lighting market for new installation based on region was valued at USD 27,592.4 million in 2015 and is expected to reach USD 58,476.7 million by 2022, growing at a CAGR of 10.78% during the forecast period. The market in Asia-Pacific was valued at USD 12,323.8 million in 2015 and is expected to reach USD 27,942.8 million by 2022, growing at a CAGR of 12.09% during the forecast period. High demand for new construction and increasing affordability of LEDs are strengthening the position of APAC in the global LED lighting market. Moreover, huge economic growth of developing nations such as China, India, and ASEAN countries is fueling the growth of the LED lighting market in the region. The market in RoW is expected to be valued at USD 7,310.3 million by 2022, growing at the highest CAGR of 12.96% during the forecast period.

7.3 RETROFIT

Retrofit lamps refer to those LED lamps that are used to partially replace existing lighting fixtures with LED lamps and nonintegrated luminaires and controls (such as LED drivers), to replace the traditional light sources. LED provides significant energy saving, fast illumination, and a high degree of working life which can be more than 25 times longer than incandescent lamps.

Retrofit lamps considered for the study include A-lamps, T-lamps, reflectors, and other lamps such as high/low-bay and decorative lamps.

7.3.1 A-LAMPS

A-lamps include LED replacement lamps for standard incandescent lamps. A-lamps are considered the classic replacement type of light bulbs that have been used for general-purpose lighting for over 100 years. These lamps have a medium screw base and typically have a pear-like shape.

7.3.2 T-LAMPS

Linear T-lamps are widely used in commercial and industrial lighting as they offer a cheaper, efficient, and long-lasting light source. As a result, these retrofit systems represent nearly half of all lighting services (in lumen-hour) in the U.S. Because of the significant lighting service required by these applications, the penetration of LED lighting as a replacement for linear fluorescent lamps has the potential to greatly reduce total energy consumption. Modern linear fluorescent lamps and ballast systems are tough competitors to LEDs in terms of efficacy as well as initial and life cycle costs, with efficacies as high as 108lm/W and prices as low as USD4/klm.

7.3.3 REFLECTORS

LEDs are different from conventional light sources in ways of optical behavior where they emit light in an omnidirectional manner and require a reflector to shape the radiation. LED point sources radiate in one hemisphere and often require the use of collimators in the form of total internal reflection (TIR) lenses to steer the beam. The layered structure of an LED chip and its built-in primary optics in the module always make the emission of light Lambertian in nature. This basic emission is also influenced by additional optical means that are integrated into the LED—mostly features a reduced beam angle. Optic control is usually applied with collimator lenses and reflectors—bulk optics that implement TIR.

7.3.3.1 Multifaceted reflector (MR) lamps

MR lamps are a type of reflector lamps mainly used by halogen lamps, but they are also used by LED replacement lamps and fluorescent lamps.

They were originally used for slide projectors but have also found applications in residential and commercial lighting. MR lamps usually find applications where directional lighting is required such as track lighting, recessed ceiling lights, desk lamps, pendant fixtures, landscape lighting, and retail display lighting.

7.3.4 OTHER LAMPS

Other retrofit lamps considered for the study are high/low-bay lamps and decorative lamps.

Decorative lamps cover a range of bulb shapes which include bullet, globe, flame, and candle. These are mostly used in residential lighting and are typically used in fixtures such as chandeliers, pendants, wall sconces, lanterns, and night-lights. They have low lumen outputs and high color quality. The bulbs also provide an esthetic contribution to a space and are installed in open fixtures where an omnidirectional intensity distribution is generally preferred.

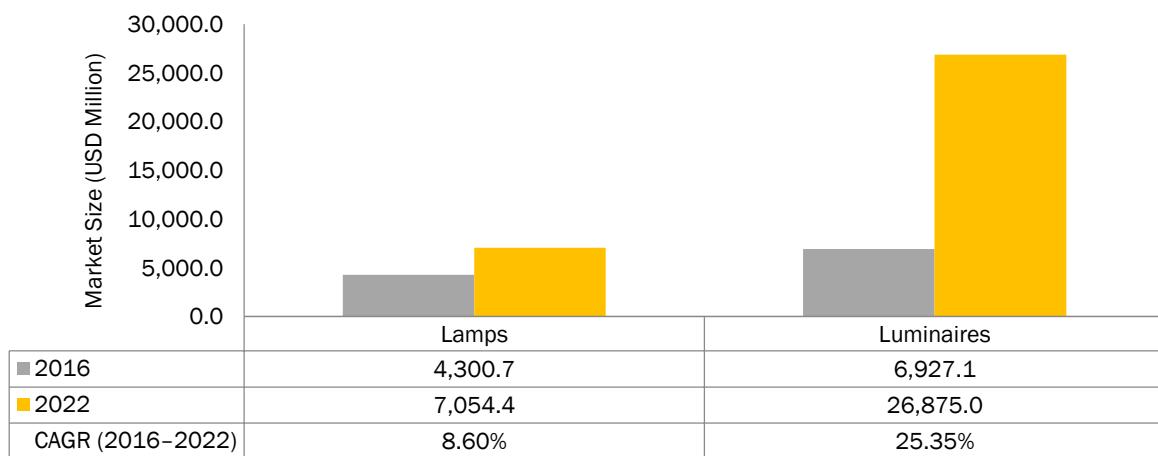
TABLE 11 LED LIGHTING MARKET FOR RETROFIT INSTALLATION, BY PRODUCT TYPE, 2013–2022 (USD MILLION)

Product Type	2013	2014	2015	2016	2018	2020	2022	CAGR (2016–2022)
Lamps	2,953.7	3,404.1	3,852.7	4,300.7	5,200.1	6,114.0	7,054.4	8.60%
Luminaires	2,673.2	3,908.4	5,306.8	6,927.1	11,144.9	17,386.4	26,875.0	25.35%
Total	5,626.9	7,312.5	9,159.5	11,227.8	16,345.0	23,500.4	33,929.4	20.24%

Source: Experts' Interviews, Secondary Research, and MarketsandMarkets Analysis

The LED lighting market for retrofit installation based on product type was valued at USD 9,159.5 million in 2015 and is expected to reach USD 33,929.4 million by 2022, growing at a CAGR of 20.24% during the forecast period. The market for luminaires was valued at USD 5,306.8 million in 2015 and is expected to reach USD 26,875.0 million by 2022, growing at the highest CAGR of 25.35% during the forecast period.

FIGURE 32 LED LIGHTING MARKET FOR RETROFIT INSTALLATION, BY PRODUCT TYPE (USD MILLION)



Source: Industry Journals, Experts' Interviews, and MarketsandMarkets Analysis.

TABLE 12 LED LIGHTING MARKET FOR RETROFIT INSTALLATION, BY PRODUCT TYPE, 2013–2022 (MILLION UNITS)

Product Type	2013	2014	2015	2016	2018	2020	2022	CAGR (2016–2022)
Lamps	435.0	514.1	597.1	684.5	874.6	1,090.3	1,338.6	11.83%
Luminaires	410.0	625.4	887.8	1,213.9	2,158.0	3,761.5	6,587.0	32.56%
Total	845.0	1,139.6	1,484.9	1,898.3	3,032.6	4,851.7	7,925.6	26.89%

Source: Experts' Interviews, Secondary Research, and MarketsandMarkets Analysis

The LED lighting market for retrofit installation based on product type registered a shipment of 1,484.9 million units in 2015 and is expected to reach 7,925.6 million units by 2022, at a CAGR of 26.89% during the forecast period. The luminaires segment registered the highest shipment of 887.8 million units in

2015 and is expected to reach 6,587.0 million units by 2022, at the highest CAGR of 32.56% during the forecast period.

TABLE 13 RETROFIT INSTALLATION LED LIGHTING MARKET FOR INDOOR LIGHTING, BY TYPE, 2013–2022 (USD MILLION)

Type	2013	2014	2015	2016	2018	2020	2022	CAGR (2016–2022)
Residential	2,735.2	3,508.4	4,335.6	5,241.0	7,407.9	10,314.0	14,368.0	18.30%
Commercial	2,135.5	2,784.9	3,500.2	4,304.9	6,306.5	9,119.4	13,230.7	20.58%
Industrial	194.6	267.2	354.3	460.5	758.6	1,248.2	2,093.6	28.71%
Others	57.0	84.0	117.8	159.8	277.1	461.8	756.7	29.59%
Total	5,122.2	6,644.5	8,308.0	10,166.1	14,750.2	21,143.4	30,448.9	20.06%

Source: Experts' Interviews, Secondary Research, and MarketsandMarkets Analysis

The LED lighting market for retrofit installation based on the indoor lighting end-use application was valued at USD 8,308.0 million in 2015 and is expected to reach USD 30,448.9 million by 2022, growing at a CAGR of 20.06% during the forecast period. The market for the residential application was valued at USD 4,335.6 million in 2015 and is expected to reach USD 14,368.0 million by 2022, growing at a CAGR of 18.30% during the forecast period. The market for other indoor lighting applications is expected to be valued at USD 756.7 million by 2022, growing at the highest CAGR of 29.59% during the forecast period. The market for the industrial application is expected to witness a high growth of 28.71% during the forecast period as LED penetration in this segment is total cost of ownership (TCO). LEDs can reduce lighting maintenance costs significantly, especially in high, hard-to-reach places (high-bay lighting).

TABLE 14 RETROFIT INSTALLATION LED LIGHTING MARKET FOR OUTDOOR LIGHTING, BY TYPE, 2013–2022 (USD MILLION)

Type	2013	2014	2015	2016	2018	2020	2022	CAGR (2016–2022)
Highway & Roadway	320.1	426.9	548.5	689.2	1,052.5	1,583.8	2,387.7	23.01%
Architectural	148.8	193.3	241.8	295.6	426.1	601.7	842.2	19.06%
Public Places	26.9	36.0	46.3	58.1	87.5	127.9	183.1	21.08%
Others	8.8	11.7	14.9	18.7	28.6	43.6	67.4	23.83%
Total	504.7	668.0	851.6	1,061.7	1,594.8	2,357.0	3,480.4	21.88%

Source: Experts' Interviews, Secondary Research, and MarketsandMarkets Analysis

The LED lighting market for retrofit installation based on the outdoor lighting end-use application was valued at USD 851.6 million in 2015 and is expected to reach USD 3,480.4 million by 2022, growing at a CAGR of 21.88% during the forecast period. The market for the highway and roadway segment was valued at USD 548.5 million in 2015 and is expected to reach USD 2,387.7 million by 2022, growing at a CAGR of 23.01% during the forecast period. Increasing government spending on improving public infrastructure such as streetlights is a major factor contributing to the high growth and dominance of the highway and roadway segment. The market for other outdoor lighting applications is expected to be valued at USD 67.4 million by 2022, growing at the highest CAGR of 23.83% during the forecast period.

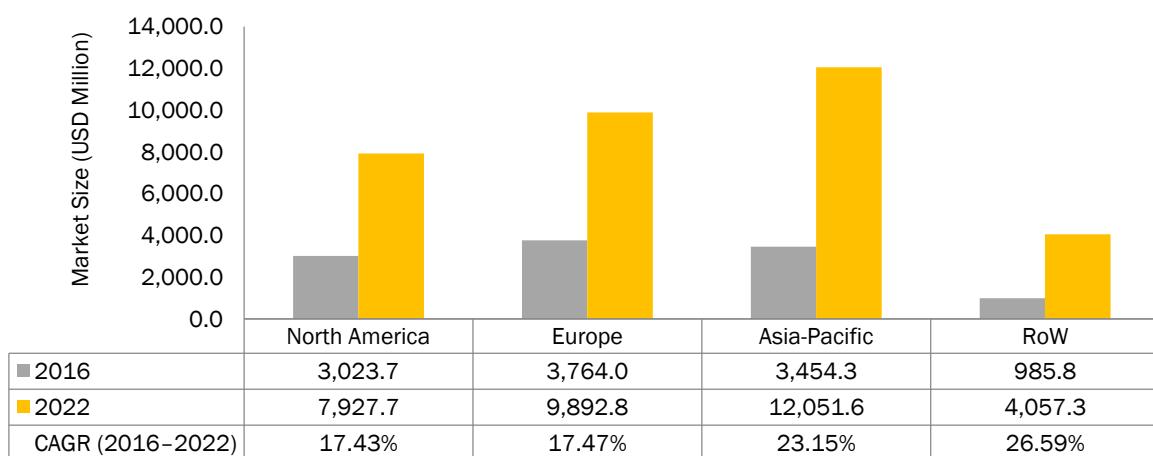
TABLE 15 LED LIGHTING MARKET FOR RETROFIT INSTALLATION, BY REGION, 2013–2022 (USD MILLION)

Region	2013	2014	2015	2016	2018	2020	2022	CAGR (2016–2022)
North America	1,553.9	2,006.0	2,507.8	3,023.7	4,136.9	5,702.6	7,927.7	17.43%
Europe	1,973.7	2,521.4	3,128.8	3,764.0	5,196.3	7,098.1	9,892.8	17.47%
Asia-Pacific	1,644.6	2,170.1	2,766.1	3,454.3	5,318.5	8,113.5	12,051.6	23.15%
RoW	454.6	614.9	756.8	985.8	1,693.3	2,586.2	4,057.3	26.59%
Total	5,626.9	7,312.5	9,159.5	11,227.8	16,345.0	23,500.4	33,929.4	20.24%

Source: Experts' Interviews, Secondary Research, and MarketsandMarkets Analysis

The LED lighting market for retrofit installation based on region was valued at USD 9,159.5 million in 2015 and is expected to reach USD 33,929.4 million by 2022, growing at a CAGR of 20.24% during the forecast period. The European market was valued at USD 3,128.8 million in 2015 and is expected to reach USD 9,892.8 million by 2022, growing at a CAGR of 17.47% during the forecast period. The market in RoW is expected to be valued at USD 4,057.3 million by 2022, growing at the highest CAGR of 26.59% during the forecast period.

FIGURE 33 LED LIGHTING MARKET FOR RETROFIT INSTALLATION, BY REGION (USD MILLION)



Source: Industry Journals, Experts' Interviews, and MarketsandMarkets Analysis.

8 LED LIGHTING MARKET, BY END-USE APPLICATION

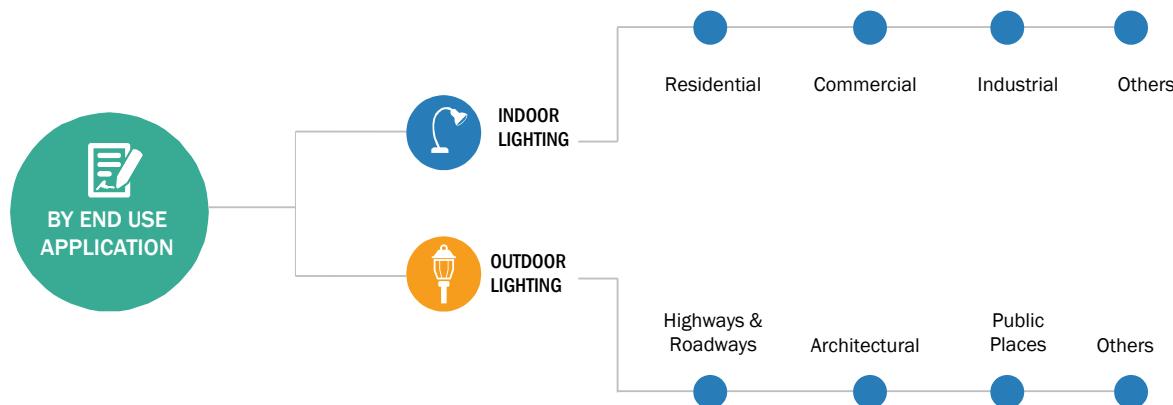
KEY FINDINGS

- The LED lighting market for indoor lighting application was valued at USD 29.41 billion in 2015 and is expected to reach USD 74.31 billion by 2022, growing at the highest CAGR of 13.75% during the forecast period.
- The shipment for outdoor lighting application is expected to reach 996.4 million units by 2022, at the highest CAGR of 23.52% during the forecast period.
- Increasing focus on enhancing connectivity by building roads and road lights, especially in the developing countries of the APAC region, would spur the growth of the outdoor LED lighting market.
- Increase in infrastructure-building activities, a large chunk of which is the residential sector, is the major factor contributing to the high growth of the residential indoor lighting end-use application.
- The market for architectural outdoor lighting application based on region was valued at USD 3.77 billion in 2015 and is expected to reach USD 8.32 billion by 2022, growing at a CAGR of 11.43% during the forecast period.

8.1 INTRODUCTION

LED lighting systems offer a significant opportunity to eliminate waste, reduce energy consumption, and save cost. Lighting is an important factor in energy consumption which is gaining recognition as the most efficient strategy for energy savings among various end users. This section describes the various end-use applications of LED lighting. The LED lighting market has been segmented on the basis of end-use application into indoor lighting and outdoor lighting.

FIGURE 34 LED LIGHTING MARKET, BY END-USE APPLICATION



Note: Other indoor lighting applications include government and public buildings; other outdoor lighting applications include rail lines and harbors.

Source: Lighting Controls Association (U.S.), National Electrical Manufacturers Association (NEMA, U.S.), Industry Journals, Experts' Interviews, and MarketsandMarkets Analysis

TABLE 16 LED LIGHTING MARKET, BY END-USE APPLICATION, 2013–2022 (USD MILLION)

End-Use Application	2013	2014	2015	2016	2018	2020	2022	CAGR (2016–2022)
Indoor Lighting	20,197.0	24,740.4	29,418.1	34,303.3	45,066.5	57,966.0	74,313.9	13.75%
Outdoor Lighting	5,025.0	6,159.2	7,333.8	8,561.2	11,237.3	14,343.8	18,092.2	13.28%
Total	25,222.1	30,899.5	36,751.9	42,864.5	56,303.7	72,309.8	92,406.1	13.66%

Source: Experts' Interviews, Secondary Research, and MarketsandMarkets Analysis

The LED lighting market based on end-use application was valued at USD 36,751.9 million in 2015 and is expected to reach USD 92,406.1 million by 2022, growing at a CAGR of 13.66% during the forecast period. The market for indoor lighting application was valued at USD 29,418.1 million in 2015 and is expected to reach USD 74,313.9 million by 2022, growing at the highest CAGR of 13.75% during the forecast period. The large market size and high growth rate of indoor lighting application is attributed to the increasing infrastructural activities across the world, mainly focused on residential lighting.

TABLE 17 LED LIGHTING MARKET, BY END-USE APPLICATION, 2013–2022 (MILLION UNITS)

End-Use Application	2013	2014	2015	2016	2018	2020	2022	CAGR (2016–2022)
Indoor Lighting	2,104.1	2,702.8	3,372.2	4,133.3	6,050.8	8,805.2	13,017.4	21.07%
Outdoor Lighting	133.8	175.8	224.1	280.6	428.1	648.4	996.4	23.52%
Total	2,237.9	2,878.6	3,596.3	4,413.9	6,478.9	9,453.7	14,013.8	21.23%

Source: Experts' Interviews, Secondary Research, and MarketsandMarkets Analysis

The LED lighting market based on end-use application registered a shipment of 3,596.3 million units in 2015 and is expected to reach 14,013.8 million units by 2022, at a CAGR of 21.23% during the forecast period. The indoor lighting segment registered the highest shipment of 3,372.2 million units in 2015 and is expected to reach 13,017.4 million units by 2022, at a CAGR of 21.07% during the forecast period. However, shipment for the outdoor lighting segment is expected to reach 996.4 million units by 2022, at the highest CAGR of 23.52% during the forecast period. Increasing focus on enhancing connectivity by building roads and road lights, especially in the developing countries of the APAC region, would spur the growth of the outdoor LED lighting market.

8.1.1 INDOOR LIGHTING

The LED lighting market for the indoor lighting application has been segmented into residential, commercial, industrial, and others such as government and public buildings.

8.1.1.1 Residential

LED lighting for residential buildings is expected to have a huge potential in the future. It is expected to witness a high growth rate. However, the high installation cost is the major restraint for this application of LED lighting. Additionally, LED lighting products are more expensive than conventional lighting products, which would make it difficult for individual buyers to purchase these products. However, countries with a high per capita income would implement LED lighting solutions for residential applications. For instance, U.S., Canada, and European countries such as U.K. and Germany would have huge market for LED lighting systems in the near future.

8.1.1.1.1 Increasing standard of living

Economies with a high per capita income of population are expected to implement energy-efficient lighting solutions. U.S., Canada, and European countries such as U.K. and Germany are expected to hold a large market size for light switches and dimmers during the forecast period.

8.1.1.2 Commercial

The commercial end-use applications include offices, retail shops and malls, and hospitals. Reducing energy consumption has become a major objective for building owners, governments, utilities, and many other stakeholders. Replacing existing lights with more energy-efficient lighting sources (such as LEDs) is one of the ways to reduce this massive pool of energy use, but it is a small-scale solution. Energy reduction on a large scale can be achieved by turning off the lights when not required, optimizing light levels to suit worker needs, and reducing the overall demand for lighting energy. Adding LED lighting controls in lighting is the best way to ensure that lighting energy is automatically reduced as much as possible. According to the findings of the U.S. Energy Information Administration (EIA), the lighting control solutions based on different technologies have been proven to reduce the lighting energy consumption in commercial buildings by up to 70%. These solutions have been restricted in the past by cost, complexity, and applicability. However, new wireless technologies are providing ways to expand the capabilities of lighting control and offer them to a wider set of customers.

8.1.1.2.1 Office lighting

LED lighting provides appropriate lighting conditions at offices, instrumental in increasing workforce productivity and improving working conditions. On the other hand, improper lighting may cause personal injury including retinal fatigue caused by poor lighting and mental fatigue caused by intense light, display reflection, and other poor lighting designs. This factor is vital for modern office workers as at least 70% of them have to work in front of computer screens for more than 6 hours a day. Good lighting design based on the LED lighting concept not only enhances the efficiency of workers but also improves their overall productivity. Office lighting based on LED lighting technology ensures proper light sources and brightness, which in turn takes care of workers' physiological and psychological well-being.

8.1.1.2.2 Retail malls

Interactions between customers in the shopping mall and the merchandise are supported by mall equipment, sound system, and lighting. The design of mall lighting systems is done in a way to attract consumers as well as promote the attributes, values, and information related to the merchandise. These play a vital role in the overall spatial presentation of the mall. Different lighting arrangements and patterns are designed to showcase certain merchandise for certain sets of customers of different genders, ages, and incomes. All these lighting arrangements are designed to adapt to a variety of merchandise.

8.1.1.2.3 Hospitality

LED lighting systems in hotels are instrumental in attracting guests and making the customers feel comfortable in a bright environment. The focus of hotel management is currently on attracting an additional market share by appealing to diverse clientele which includes young travelers and tourists. Operational lighting requirements in hotels include front offices, restaurants, guest accommodations, entertainment venues, function/conference/seminar facilities, and architectural lighting.

8.1.1.3 Industrial

The industrial end users include factories, manufacturing units, warehouses, and many more. In industrial settings, safety is a primary concern and proper lighting and adequate illumination is a key factor in maintaining high worker productivity. The improper application of lighting can result in excessive lighting, leading to energy wastage. The industrial end users can save on lighting expenses and conserve energy by implementing controlled lighting using LED lighting systems.

8.1.1.3.1 Safety of workers in industrial areas

In industrial settings, safety is a primary concern and proper lighting and adequate illumination is essential to ensure proper functioning of production floors, storage units in warehouses, and overall workforce productivity. In many factories and warehouses, there is often round-the-clock illumination. Therefore, lighting is often a large consumer of energy besides process equipment. Improper lighting can result in huge amounts of energy wastage. Industrial lighting can help save lighting expenses and conserve energy by implementing controlled lighting using light switches and dimmers.

8.1.1.4 Others

8.1.1.4.1 Government and public buildings

Public and government buildings are an important application area among the other applications in the LED lighting market. As LED lighting projects for public and government buildings are funded by the government, the growth of this application is expected to be consistent as it would be given priority in every country.

Every lighting control project in public and government buildings requires specific solutions that are appropriate for the buildings. As different types of spaces in public and government buildings need different control strategies, many projects need multiple solutions to take full advantage of energy savings. Scheduling, occupancy, and daylight harvesting are the most prominent light control strategies used in these application areas. As the LED lighting projects for public and government buildings are funded by the government, these projects require adherence to a number of regulations including energy codes, sustainable building rating systems, and specific legislations according to different countries.

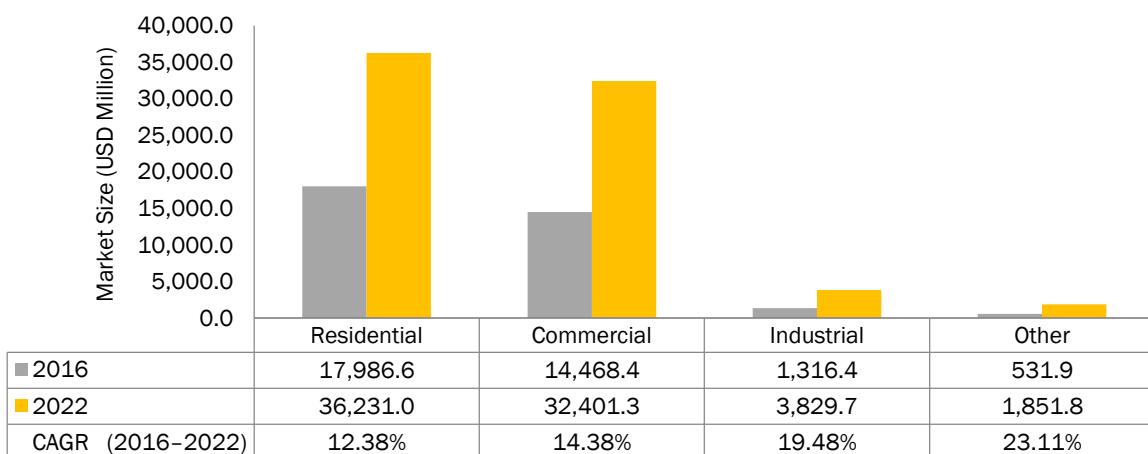
TABLE 18 LED LIGHTING MARKET FOR INDOOR LIGHTING APPLICATION, BY TYPE, 2013–2022 (USD MILLION)

Type	2013	2014	2015	2016	2018	2020	2022	CAGR (2016–2022)
Residential	10,910.6	13,236.7	15,584.1	17,986.6	23,121.9	29,036.8	36,231.0	12.38%
Commercial	8,367.8	10,311.9	12,334.8	14,468.4	19,230.2	25,012.6	32,401.3	14.38%
Industrial	698.3	884.2	1,088.4	1,316.4	1,875.0	2,654.7	3,829.7	19.48%
Others	220.4	307.6	410.8	531.9	839.3	1,261.8	1,851.8	23.11%
Total	20,197.0	24,740.4	29,418.1	34,303.3	45,066.5	57,966.0	74,313.9	13.75%

Source: Experts' Interviews, Secondary Research, and MarketsandMarkets Analysis

The LED lighting market based on the indoor lighting end-use application was valued at USD 29,418.1 million in 2015 and is expected to reach USD 74,313.9 million by 2022, growing at a CAGR of 13.75% during the forecast period. The market for the residential application was valued at USD 15,584.1 million in 2015 and is expected to reach USD 36,231.0 million by 2022, growing at a CAGR of 12.38% during the forecast period. The market for other indoor lighting applications is expected to be valued at USD 1,851.8 million by 2022, growing at the highest CAGR of 23.11% during the forecast period. Increase in infrastructure-building activities, a large chunk of which is the residential sector, is the major factor contributing to the high growth of the residential indoor lighting end-use application.

FIGURE 35 LED LIGHTING MARKET FOR INDOOR LIGHTING APPLICATION, BY TYPE (USD MILLION)



Source: Industry Journals, Experts' Interviews, and MarketsandMarkets Analysis

TABLE 19 LED LIGHTING MARKET FOR INDOOR LIGHTING APPLICATION, BY TYPE, 2013–2022 (MILLION UNITS)

Type	2013	2014	2015	2016	2018	2020	2022	CAGR (2016–2022)
Residential	1,647.8	2,103.1	2,607.0	3,174.4	4,585.7	6,583.5	9,599.4	20.25%
Commercial	389.2	504.4	634.8	784.9	1,169.1	1,730.8	2,602.4	22.11%
Industrial	50.8	69.9	93.0	121.1	198.2	319.0	517.1	27.37%
Others	16.3	25.5	37.4	52.8	97.7	172.0	298.5	33.46%
Total	2,104.1	2,702.8	3,372.2	4,133.3	6,050.8	8,805.2	13,017.4	21.07%

Source: Experts' Interviews, Secondary Research, and MarketsandMarkets Analysis

The indoor lighting end-use application of the LED lighting market based on type registered a shipment of 3,372.2 million units in 2015 and is expected to reach 13,017.4 million units by 2022, at a CAGR of 21.07% during the forecast period. The residential application registered the highest shipment of 2,607.0 million units in 2015 and is expected to reach 9,599.4 million units by 2022, at a CAGR of 20.25% during the forecast period. However, shipment for other indoor lighting applications is expected to reach 298.5 million units by 2022, at the highest CAGR of 33.46% during the forecast period. Industrial lighting is expected to experience high growth during the forecast period as LEDs can reduce lighting maintenance costs significantly, especially in high, hard-to-reach places (high-bay lighting), in an industrial workplace.

TABLE 20 LED LIGHTING MARKET FOR INDOOR LIGHTING APPLICATION, BY REGION, 2013–2022 (USD MILLION)

Region	2013	2014	2015	2016	2018	2020	2022	CAGR (2016–2022)
North America	4,364.8	5,338.7	6,333.9	7,288.7	9,124.8	11,296.2	14,134.7	11.67%
Europe	5,609.0	6,858.3	8,130.2	9,371.3	11,974.8	14,927.3	18,873.4	12.38%
APAC	8,297.8	10,093.9	12,078.7	14,038.2	18,919.7	25,085.7	32,163.9	14.82%
RoW	1,925.4	2,449.5	2,875.3	3,605.1	5,047.2	6,656.8	9,141.9	16.78%
Total	20,197.0	24,740.4	29,418.1	34,303.3	45,066.5	57,966.0	74,313.9	13.75%

Source: Experts' Interviews, Secondary Research, and MarketsandMarkets Analysis

The LED lighting market for the indoor lighting end-use application based on region was valued at USD 29,418.1 million in 2015 and is expected to reach USD 74,313.9 million by 2022, growing at a CAGR of 13.75% during the forecast period. The market in APAC was valued at USD 12,078.7 million in 2015 and is expected to reach USD 32,163.9 million by 2022, growing at a CAGR of 14.82% during the forecast period. The market in RoW is expected to be valued at USD 9,141.9 million by 2022, growing at the highest CAGR of 16.78% during the forecast period. The APAC region accounts for a large share of global construction investment, a significant portion of which would be invested in the lighting industry, especially in the indoor lighting sector.

TABLE 21 LED LIGHTING MARKET FOR INDOOR LIGHTING APPLICATION, BY REGION, 2013–2022 (MILLION UNITS)

Region	2013	2014	2015	2016	2018	2020	2022	CAGR (2016–2022)
North America	454.7	583.2	726.1	878.2	1,225.1	1,715.9	2,475.9	18.86%
Europe	584.3	749.2	932.0	1,129.2	1,607.8	2,267.5	3,306.0	19.61%
APAC	864.4	1,102.7	1,384.6	1,691.5	2,540.2	3,810.6	5,634.1	22.21%
RoW	200.6	267.6	329.6	434.4	677.6	1,011.2	1,601.4	24.29%
Total	2,104.1	2,702.8	3,372.2	4,133.3	6,050.8	8,805.2	13,017.4	21.07%

Source: Experts' Interviews, Secondary Research, and MarketsandMarkets Analysis

The indoor lighting end-use application of the LED lighting market based on region registered a shipment of 3,372.2 million units in 2015 and is expected to reach 13,017.4 million units by 2022, at a CAGR of 21.07% during the forecast period. The APAC region registered the highest shipment of 1,384.6 million units in 2015 and is expected to reach 5,634.1 million units by 2022, at a CAGR of 22.21% during the forecast period. However, shipment for the RoW region is expected to reach 1,601.4 million units by 2022, at the highest CAGR of 24.29% during the forecast period.

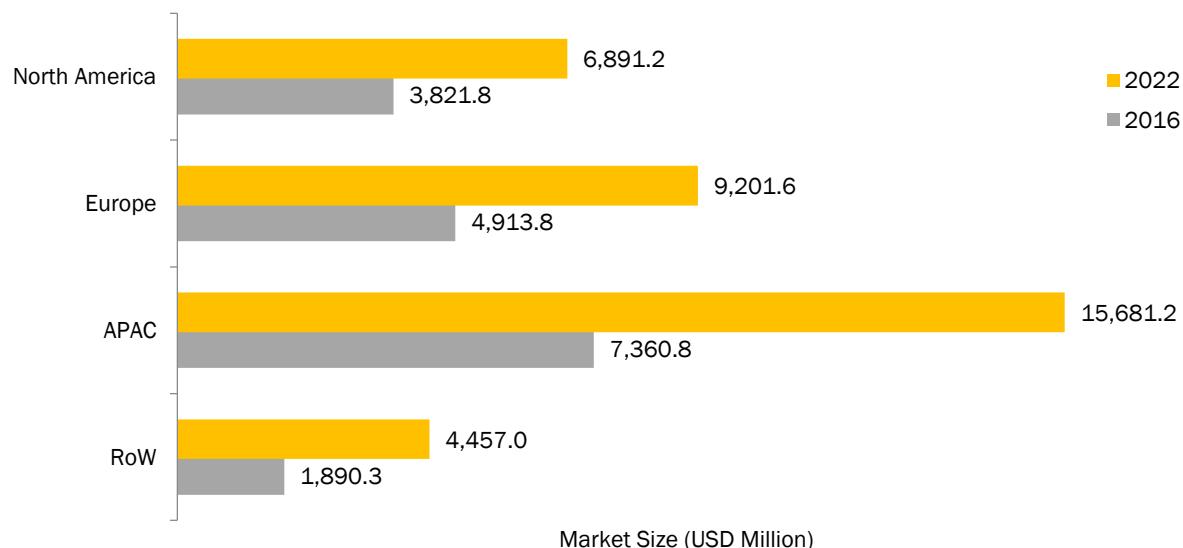
TABLE 22 LED LIGHTING MARKET FOR RESIDENTIAL INDOOR LIGHTING APPLICATION, BY REGION, 2013–2022 (USD MILLION)

Region	2013	2014	2015	2016	2018	2020	2022	CAGR (2016–2022)
North America	2,357.9	2,856.3	3,355.3	3,821.8	4,681.6	5,658.6	6,891.2	10.32%
Europe	3,030.0	3,669.4	4,306.9	4,913.8	6,143.8	7,477.5	9,201.6	11.02%
APAC	4,482.6	5,400.5	6,398.6	7,360.8	9,707.0	12,566.1	15,681.2	13.43%
RoW	1,040.1	1,310.5	1,523.2	1,890.3	2,589.5	3,334.6	4,457.0	15.37%
Total	10,910.6	13,236.7	15,584.1	17,986.6	23,121.9	29,036.8	36,231.0	12.38%

Source: Experts' Interviews, Secondary Research, and MarketsandMarkets Analysis

The LED lighting market for the residential indoor lighting end-use application based on region was valued at USD 15,584.1 million in 2015 and is expected to reach USD 36,231.0 million by 2022, growing at a CAGR of 12.38% during the forecast period. The market in APAC was valued at USD 6,398.6 million in 2015 and is expected to reach USD 15,681.2 million by 2022, growing at a CAGR of 13.43% during the forecast period. The market in RoW is expected to be valued at USD 4,457.0 million by 2022, growing at the highest CAGR of 15.37% during the forecast period. Implementation of smart city projects in many countries of the APAC region such as India and China is the reason behind the dominance of this region in the LED lighting market for residential end-use application.

FIGURE 36 LED LIGHTING MARKET FOR RESIDENTIAL INDOOR LIGHTING APPLICATION, BY REGION (USD MILLION)



Source: Industry Journals, Experts' Interviews, and MarketsandMarkets Analysis

TABLE 23 LED LIGHTING MARKET FOR COMMERCIAL INDOOR LIGHTING APPLICATION, BY REGION, 2013–2022 (USD MILLION)

Region	2013	2014	2015	2016	2018	2020	2022	CAGR (2016–2022)
North America	1,808.4	2,225.2	2,655.8	3,074.2	3,893.6	4,874.4	6,162.8	12.29%
Europe	2,323.8	2,858.6	3,409.0	3,952.6	5,109.7	6,441.2	8,228.9	13.00%
APAC	3,437.9	4,207.2	5,064.5	5,921.0	8,073.2	10,824.6	14,023.7	15.45%
RoW	797.7	1,021.0	1,205.6	1,520.6	2,153.7	2,872.5	3,985.9	17.42%
Total	8,367.8	10,311.9	12,334.8	14,468.4	19,230.2	25,012.6	32,401.3	14.38%

Source: Experts' Interviews, Secondary Research, and MarketsandMarkets Analysis

The LED lighting market for the commercial indoor lighting end-use application based on region was valued at USD 12,334.8 million in 2015 and is expected to reach USD 32,401.3 million by 2022, growing at a CAGR of 14.38% during the forecast period. The market in APAC was valued at USD 5,064.5 million in 2015 and is expected to reach USD 14,023.7 million by 2022, growing at a CAGR of 15.45% during the forecast period. The market in RoW is expected to be valued at USD 3,985.9 million by 2022, growing at the highest CAGR of 17.42% during the forecast period. The commercial sector comprising retail, offices, and hospitals is fast growing in the APAC region owing to the growing economic prosperity of the countries in this region. This is likely to fuel the demand for LED lighting in these industries, and it is the main reason why APAC is expected to experience high growth.

TABLE 24 LED LIGHTING MARKET FOR INDUSTRIAL INDOOR LIGHTING APPLICATION, BY REGION, 2013–2022 (USD MILLION)

Region	2013	2014	2015	2016	2018	2020	2022	CAGR (2016–2022)
North America	150.9	190.8	234.3	279.7	379.6	517.3	728.4	17.30%
Europe	193.9	245.1	300.8	359.6	498.2	683.6	972.6	18.04%
APAC	286.9	360.7	446.9	538.7	787.2	1,148.9	1,657.5	20.60%
RoW	66.6	87.5	106.4	138.3	210.0	304.9	471.1	22.66%
Total	698.3	884.2	1,088.4	1,316.4	1,875.0	2,654.7	3,829.7	19.48%

Source: Experts' Interviews, Secondary Research, and MarketsandMarkets Analysis

The LED lighting market for the industrial indoor lighting end-use application based on region was valued at USD 1,088.4 million in 2015 and is expected to reach USD 3,829.7 million by 2022, growing at a CAGR of 19.48% during the forecast period. The market in APAC was valued at USD 446.9 million in 2015 and is expected to reach USD 1,657.5 million by 2022, growing at a CAGR of 20.60% during the forecast period. The market in RoW is expected to be valued at USD 471.1 million by 2022, growing at the highest CAGR of 22.66% during the forecast period. The APAC region is one of the largest manufacturing hubs in the world, mostly dominated by the developing economies such as China and India, as well as the developed economies of South Korea and Japan. The industrial places of these countries are implementing LED lighting for long-term benefits as well as to cut energy costs.

TABLE 25 LED LIGHTING MARKET FOR OTHER INDOOR LIGHTING APPLICATIONS, BY REGION, 2013–2022 (USD MILLION)

Region	2013	2014	2015	2016	2018	2020	2022	CAGR (2016–2022)
North America	47.6	66.4	88.4	113.0	169.9	245.9	352.2	20.86%
Europe	61.2	85.3	113.5	145.3	223.0	324.9	470.3	21.62%
APAC	90.5	125.5	168.7	217.7	352.3	546.1	801.5	24.26%
RoW	21.0	30.5	40.2	55.9	94.0	144.9	227.8	26.38%
Total	220.4	307.6	410.8	531.9	839.3	1,261.8	1,851.8	23.11%

Source: Experts' Interviews, Secondary Research, and MarketsandMarkets Analysis

The LED lighting market for other indoor lighting end-use applications based on region was valued at USD 410.8 million in 2015 and is expected to reach USD 1,851.8 million by 2022, growing at a CAGR of 23.11% during the forecast period. The market in APAC was valued at USD 168.7 million in 2015 and is expected to reach USD 801.5 million by 2022, growing at a CAGR of 24.26% during the forecast period. The market in RoW is expected to be valued at USD 227.8 million by 2022, growing at the highest CAGR of 26.38% during the forecast period.

TABLE 26 LED LIGHTING MARKET FOR INDOOR LIGHTING APPLICATION, BY INSTALLATION TYPE, 2013–2022 (USD MILLION)

Installation Type	2013	2014	2015	2016	2018	2020	2022	CAGR (2016–2022)
New Installation	15,074.8	18,095.8	21,110.1	24,137.2	30,316.2	36,822.6	43,864.9	10.47%
Retrofit Installation	5,122.2	6,644.5	8,308.0	10,166.1	14,750.2	21,143.4	30,448.9	20.06%
Total	20,197.0	24,740.4	29,418.1	34,303.3	45,066.5	57,966.0	74,313.9	13.75%

Source: Experts' Interviews, Secondary Research, and MarketsandMarkets Analysis

The LED lighting market for indoor lighting end-use application based on installation type was valued at USD 29,418.1 million in 2015 and is expected to reach USD 74,313.9 million by 2022, growing at a CAGR of 13.75% during the forecast period. The market for new installation was valued at USD 21,110.1 million in 2015 and is expected to reach USD 43,864.9 million by 2022, growing at a CAGR of 10.47% during the forecast period. The market for retrofit installation is expected to be valued at USD 30,448.9 million by 2022, growing at the highest CAGR of 20.06% during the forecast period. Retrofit installation is expected to witness high growth as all the traditional light sources are being retrofitted with LED lamps and luminaires compared to new installation of LED lamps and luminaires.

TABLE 27 LED LIGHTING MARKET FOR RESIDENTIAL INDOOR LIGHTING APPLICATION, BY INSTALLATION TYPE, 2013–2022 (USD MILLION)

Installation Type	2013	2014	2015	2016	2018	2020	2022	CAGR (2016–2022)
New Installation	8,175.4	9,728.4	11,248.4	12,745.6	15,714.0	18,722.8	21,863.0	9.41%
Retrofit Installation	2,735.2	3,508.4	4,335.6	5,241.0	7,407.9	10,314.0	14,368.0	18.30%
Total	10,910.6	13,236.7	15,584.1	17,986.6	23,121.9	29,036.8	36,231.0	12.38%

Source: Experts' Interviews, Secondary Research, and MarketsandMarkets Analysis

The LED lighting market for the residential indoor lighting end-use application based on installation type was valued at USD 15,584.1 million in 2015 and is expected to reach USD 36,231.0 million by 2022, growing at a CAGR of 12.38% during the forecast period. The market for new installation was valued at USD 11,248.4 million in 2015 and is expected to reach USD 21,863.0 million by 2022, growing at a CAGR of 9.41% during the forecast period. The market for retrofit installation is expected to be valued at USD 14,368.0 million by 2022, growing at the highest CAGR of 18.30% during the forecast period. The new installation segment is expected to dominate the residential sector as it is more economically feasible for the civilian population to install completely new LED fixtures with a longer operating life instead of partially retrofitting old incandescent lamps with LED lamps.

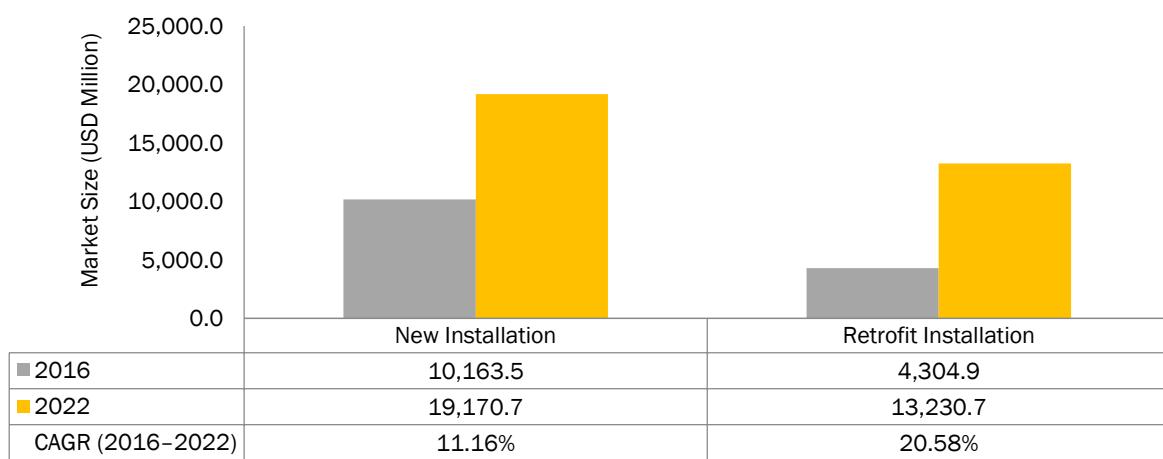
TABLE 28 LED LIGHTING MARKET FOR COMMERCIAL INDOOR LIGHTING APPLICATION, BY INSTALLATION TYPE, 2013–2022 (USD MILLION)

Installation Type	2013	2014	2015	2016	2018	2020	2022	CAGR (2016–2022)
New Installation	6,232.3	7,527.0	8,834.6	10,163.5	12,923.7	15,893.2	19,170.7	11.16%
Retrofit Installation	2,135.5	2,784.9	3,500.2	4,304.9	6,306.5	9,119.4	13,230.7	20.58%
Total	8,367.8	10,311.9	12,334.8	14,468.4	19,230.2	25,012.6	32,401.3	14.38%

Source: Experts' Interviews, Secondary Research, and MarketsandMarkets Analysis

The LED lighting market for the commercial indoor lighting end-use application based on installation type was valued at USD 12,334.8 million in 2015 and is expected to reach USD 32,401.3 million by 2022, growing at a CAGR of 14.38% during the forecast period. The market for new installation was valued at USD 8,834.6 million in 2015 and is expected to reach USD 19,170.7 million by 2022, growing at a CAGR of 11.16% during the forecast period. The market for retrofit installation is expected to be valued at USD 13,230.7 million by 2022, growing at the highest CAGR of 20.58% during the forecast period.

FIGURE 37 LED LIGHTING MARKET FOR COMMERCIAL INDOOR LIGHTING APPLICATION, BY INSTALLATION TYPE (USD MILLION)



Source: Industry Journals, Experts' Interviews, and MarketsandMarkets Analysis

TABLE 29 LED LIGHTING MARKET FOR INDUSTRIAL INDOOR LIGHTING APPLICATION, BY INSTALLATION TYPE, 2013–2022 (USD MILLION)

Installation Type	2013	2014	2015	2016	2018	2020	2022	CAGR (2016–2022)
New Installation	503.7	617.0	734.1	855.9	1,116.4	1,406.6	1,736.1	12.51%
Retrofit Installation	194.6	267.2	354.3	460.5	758.6	1,248.2	2,093.6	28.71%
Total	698.3	884.2	1,088.4	1,316.4	1,875.0	2,654.7	3,829.7	19.48%

Source: Experts' Interviews, Secondary Research, and MarketsandMarkets Analysis

The LED lighting market for the industrial indoor lighting end-use application based on installation type was valued at USD 1,088.4 million in 2015 and is expected to reach USD 3,829.7 million by 2022, growing at a CAGR of 19.48% during the forecast period. The market for new installation was valued at USD 734.1 million in 2015 and is expected to reach USD 1,736.1 million by 2022, growing at a CAGR of 12.51% during the forecast period. The market for retrofit installation is expected to be valued at USD 2,093.6 million by 2022, growing at the highest CAGR of 28.71% during the forecast period.

TABLE 30 LED LIGHTING MARKET FOR OTHER INDOOR LIGHTING APPLICATIONS, BY INSTALLATION TYPE, 2013–2022 (USD MILLION)

Installation Type	2013	2014	2015	2016	2018	2020	2022	CAGR (2016–2022)
New Installation	163.4	223.5	293.0	372.2	562.2	800.0	1,095.1	19.71%
Retrofit Installation	57.0	84.0	117.8	159.8	277.1	461.8	756.7	29.59%
Total	220.4	307.6	410.8	531.9	839.3	1,261.8	1,851.8	23.11%

Source: Experts' Interviews, Secondary Research, and MarketsandMarkets Analysis

The LED lighting market for other indoor lighting end-use applications based on installation type was valued at USD 410.8 million in 2015 and is expected to reach USD 1,851.8 million by 2022, growing at a CAGR of 23.11% during the forecast period. The market for new installation was valued at USD 293.0 million in 2015 and is expected to reach USD 1,095.1 million by 2022, growing at a CAGR of 19.71% during the forecast period. The market for retrofit installation is expected to be valued at USD 756.7 million by 2022, growing at the highest CAGR of 29.59% during the forecast period.

8.1.2 OUTDOOR LIGHTING

The LED lighting market for the outdoor lighting application has been segmented into highway and roadway, architectural, public places such as stadiums and parks, and others such as harbors.

8.1.2.1 Highway and roadway

Street and traffic lights are the major end users of LED lights. As most lights for street and traffic lighting are funded by the government, the growth of this application is expected to be consistent as it would be given priority in most countries.

8.1.2.1.1 Different lighting controls for different types of roads, bridges, and tunnels

Every lighting control project in street lights requires specific solutions that are suitable for a particular road. As different types of roads such as streets, main roads, and highways need different control strategies, many projects need multiple solutions to take full advantage of energy savings. Scheduling,

occupancy, and daylight harvesting are the most prominent light control strategies used in these application areas. As the lighting systems for street and traffic lights are government funded, these projects have to adhere to a number of regulations including energy codes, sustainable building rating systems, and specific legislations that vary from country to country.

8.1.2.2 Architectural

LED lighting in architectural lighting uses light to shape the public buildings at night and animate heritage buildings or architectural and historical buildings, and contemporary architectural landmarks, structures, and overall skyline. It uses artificial movement of light which creates shapes and effects that add to the beauty of the building.

8.1.2.3 Public places

LED lighting for public places includes outdoor public places such as stadiums and parks. Recently, smart lights for stadiums have been installed on smart stadiums.

8.1.2.4 Others

Other outdoor lighting applications of LED lighting include rail lines and harbors.

TABLE 31 LED LIGHTING MARKET FOR OUTDOOR LIGHTING APPLICATION, BY TYPE, 2013-2022 (USD MILLION)

Type	2013	2014	2015	2016	2018	2020	2022	CAGR (2016-2022)
Highway & Roadway	2,124.3	2,644.0	3,195.0	3,784.0	5,113.4	6,728.7	8,771.8	15.04%
Architectural	2,661.9	3,216.7	3,776.9	4,347.3	5,540.5	6,846.8	8,323.7	11.43%
Public Places	167.3	211.7	259.5	311.4	429.9	573.4	749.4	15.76%
Others	71.5	86.7	102.3	118.5	153.5	194.9	247.3	13.05%
Total	5,025.0	6,159.2	7,333.8	8,561.2	11,237.3	14,343.8	18,092.2	13.28%

Source: Experts' Interviews, Secondary Research, and MarketsandMarkets Analysis

The LED lighting market based on the outdoor lighting end-use application was valued at USD 7,333.8 million in 2015 and is expected to reach USD 18,092.2 million by 2022, growing at a CAGR of 13.28% during the forecast period. The market for the architectural application was valued at USD 3,776.9 million in 2015 and is expected to reach USD 8,323.7 million by 2022, growing at a CAGR of 11.43% during the forecast period. The market for the public places application is expected to be valued at USD 749.4 million by 2022, growing at the highest CAGR of 15.76% during the forecast period. Architectural lighting is one of the early adopters of LED lamps and is the largest market within the outdoor lighting end-use application; however, it is expected to be overtaken by the highway and roadway segment due to various government supports and subsidies encouraging installation and use of LED lights.

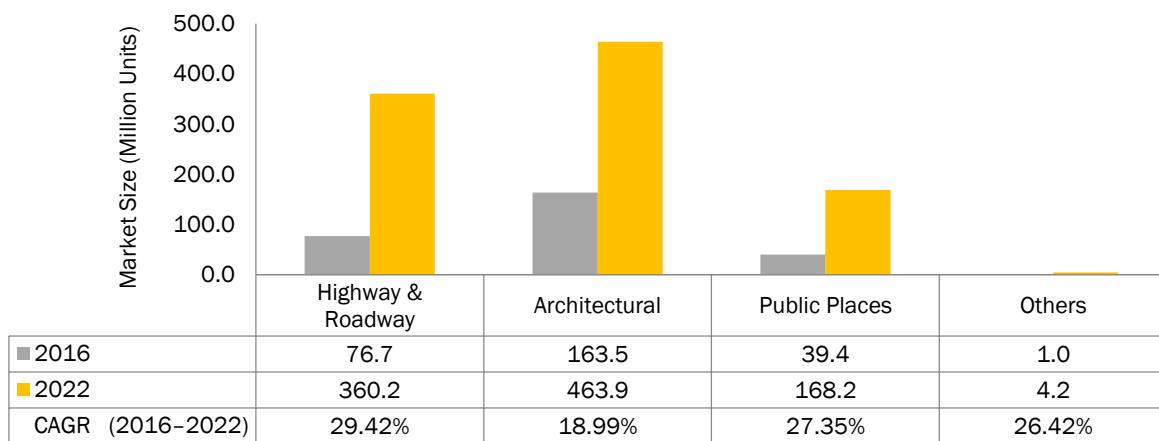
TABLE 32 LED LIGHTING MARKET FOR OUTDOOR LIGHTING APPLICATION, BY TYPE, 2013–2022 (MILLION UNITS)

Type	2013	2014	2015	2016	2018	2020	2022	CAGR (2016–2022)
Highway & Roadway	29.5	42.0	57.5	76.7	130.5	216.7	360.2	29.42%
Architectural	87.3	110.4	135.5	163.5	231.4	325.3	463.9	18.99%
Public Places	16.6	22.8	30.3	39.4	64.5	103.8	168.2	27.35%
Others	0.4	0.6	0.8	1.0	1.7	2.6	4.2	26.42%
Total	133.8	175.8	224.1	280.6	428.1	648.4	996.4	23.52%

Source: Experts' Interviews, Secondary Research, and MarketsandMarkets Analysis

The outdoor lighting end-use application of the LED lighting market based on type registered a shipment of 224.1 million units in 2015 and is expected to reach 996.4 million units by 2022, at a CAGR of 23.52% during the forecast period. The architectural application registered the highest shipment of 135.5 million units in 2015 and is expected to reach 463.9 million units by 2022, at a CAGR of 18.99% during the forecast period. However, shipment for the highway and roadway segment is expected to reach 360.2 million units by 2022, at the highest CAGR of 29.42% during the forecast period. Various government initiatives to install LED lights as well as subsidies for the price of LEDs are the major factors responsible for the dominance of the highway and roadway sector in terms of shipment units.

FIGURE 38 LED LIGHTING MARKET FOR OUTDOOR LIGHTING APPLICATION, BY TYPE (MILLION UNITS)



Source: Industry Journals, Experts' Interviews, and MarketsandMarkets Analysis

TABLE 33 LED LIGHTING MARKET FOR OUTDOOR LIGHTING APPLICATION, BY REGION, 2013–2022 (USD MILLION)

Region	2013	2014	2015	2016	2018	2020	2022	CAGR (2016–2022)
North America	1,086.0	1,329.1	1,579.0	1,819.1	2,275.3	2,795.3	3,441.2	11.21%
Europe	1,395.5	1,707.4	2,026.8	2,338.8	2,985.9	3,693.8	4,594.9	11.91%
APAC	2,064.5	2,512.9	3,011.2	3,503.6	4,717.6	6,207.5	7,830.5	14.34%
RoW	479.1	609.8	716.8	899.8	1,258.5	1,647.2	2,225.7	16.29%
Total	5,025.0	6,159.2	7,333.8	8,561.2	11,237.3	14,343.8	18,092.2	13.28%

Source: Experts' Interviews, Secondary Research, and MarketsandMarkets Analysis

The LED lighting market for the outdoor lighting end-use application based on region was valued at USD 7,333.8 million in 2015 and is expected to reach USD 18,092.2 million by 2022, growing at a CAGR of 13.28% during the forecast period. The market in APAC was valued at USD 3,011.2 million in 2015 and is expected to reach USD 7,830.5 million by 2022, growing at a CAGR of 14.34% during the forecast period. The market in RoW is expected to be valued at USD 2,225.7 million by 2022, growing at the highest CAGR of 16.29% during the forecast period. Expansion of roadways and highways to increase land trade in the APAC countries, such as the China–Pakistan Economic Corridor (CPEC), is one of the major reasons for the dominance of APAC in the outdoor lighting end-use application segment.

TABLE 34 LED LIGHTING MARKET FOR OUTDOOR LIGHTING APPLICATION, BY REGION, 2013–2022 (MILLION UNITS)

Region	2013	2014	2015	2016	2018	2020	2022	CAGR (2016–2022)
North America	28.9	37.9	48.2	59.6	86.7	126.4	189.5	21.26%
Europe	37.2	48.7	61.9	76.7	113.8	167.0	253.0	22.02%
APAC	55.0	71.7	92.0	114.8	179.7	280.6	431.2	24.68%
RoW	12.8	17.4	21.9	29.5	47.9	74.5	122.6	26.80%
Total	133.8	175.8	224.1	280.6	428.1	648.4	996.4	23.52%

Source: Experts' Interviews, Secondary Research, and MarketsandMarkets Analysis

The outdoor lighting end-use application of the LED lighting market based on region registered a shipment of 224.1 million units in 2015 and is expected to reach 996.4 million units by 2022, at a CAGR of 23.52% during the forecast period. The APAC region registered the highest shipment of 92.0 million units in 2015 and is expected to reach 431.2 million units by 2022, at a CAGR of 24.68% during the forecast period. However, shipment for the RoW region is expected to reach 122.6 million units by 2022, at the highest CAGR of 26.80% during the forecast period. The APAC region is home to some of the largest manufacturing bases of LED products. Some of the manufacturers such as Sharp Corporation (Japan) and Samsung Group (South Korea) specialize in outdoor lighting systems. This is one of the main reasons why APAC has the largest market in terms of shipment units.

TABLE 35 LED LIGHTING MARKET FOR HIGHWAY AND ROADWAY OUTDOOR LIGHTING APPLICATION, BY REGION, 2013–2022 (USD MILLION)

Region	2013	2014	2015	2016	2018	2020	2022	CAGR (2016–2022)
North America	459.1	570.6	687.9	804.0	1,035.3	1,311.3	1,668.4	12.94%
Europe	589.9	733.0	883.0	1,033.8	1,358.7	1,732.8	2,227.8	13.65%
APAC	872.8	1,078.8	1,311.8	1,548.6	2,146.7	2,912.0	3,796.5	16.12%
RoW	202.5	261.8	312.3	397.7	572.7	772.7	1,079.1	18.10%
Total	2,124.3	2,644.0	3,195.0	3,784.0	5,113.4	6,728.7	8,771.8	15.04%

Source: Experts' Interviews, Secondary Research, and MarketsandMarkets Analysis

The LED lighting market for the highway and roadway outdoor lighting end-use application based on region was valued at USD 3,195.0 million in 2015 and is expected to reach USD 8,771.8 million by 2022, growing at a CAGR of 15.04% during the forecast period. The market in APAC was valued at USD 1,311.8 million in 2015 and is expected to reach USD 3,796.5 million by 2022, growing at a CAGR of 16.12% during the forecast period. The market in RoW is expected to be valued at USD 1,079.1 million by 2022, growing at the highest CAGR of 18.1% during the forecast period. Massive highway building projects in APAC to promote transnational trades such as economic corridors are responsible for APAC's dominance in the highway and roadway subsegment.

TABLE 36 LED LIGHTING MARKET FOR ARCHITECTURAL OUTDOOR LIGHTING APPLICATION, BY REGION, 2013–2022 (USD MILLION)

Region	2013	2014	2015	2016	2018	2020	2022	CAGR (2016–2022)
North America	575.3	694.1	813.2	923.7	1,121.8	1,334.3	1,583.2	9.40%
Europe	739.2	891.7	1,043.8	1,187.6	1,472.2	1,763.2	2,114.0	10.09%
APAC	1,093.6	1,312.4	1,550.8	1,779.1	2,326.0	2,963.1	3,602.6	12.48%
RoW	253.8	318.5	369.2	456.9	620.5	786.3	1,024.0	14.40%
Total	2,661.9	3,216.7	3,776.9	4,347.3	5,540.5	6,846.8	8,323.7	11.43%

Source: Experts' Interviews, Secondary Research, and MarketsandMarkets Analysis

The market for the architectural outdoor lighting end-use application based on region was valued at USD 3,776.9 million in 2015 and is expected to reach USD 8,323.7 million by 2022, growing at a CAGR of 11.43% during the forecast period. The market in APAC market was valued at USD 1,550.8 million in 2015 and is expected to reach USD 3,602.6 million by 2022, growing at a CAGR of 12.48% during the forecast period. The market in RoW is expected to be valued at USD 1,024.0 million by 2022, growing at the highest CAGR of 14.40% during the forecast period.

TABLE 37 LED LIGHTING MARKET FOR PUBLIC PLACES OUTDOOR LIGHTING APPLICATION, BY REGION, 2013–2022 (USD MILLION)

Region	2013	2014	2015	2016	2018	2020	2022	CAGR (2016–2022)
North America	36.2	45.7	55.9	66.2	87.0	111.7	142.5	13.64%
Europe	46.5	58.7	71.7	85.1	114.2	147.7	190.3	14.36%
APAC	68.8	86.4	106.6	127.5	180.5	248.1	324.3	16.85%
RoW	16.0	21.0	25.4	32.7	48.1	65.8	92.2	18.84%
Total	167.3	211.7	259.5	311.4	429.9	573.4	749.4	15.76%

Source: Experts' Interviews, Secondary Research, and MarketsandMarkets Analysis

The LED lighting market for the public places outdoor lighting end-use application based on region was valued at USD 259.5 million in 2015 and is expected to reach USD 749.4 million by 2022, growing at a CAGR of 15.76% during the forecast period. The market in APAC was valued at USD 106.6 million in 2015 and is expected to reach USD 324.3 million by 2022, growing at a CAGR of 16.85% during the forecast period. The market in RoW is expected to be valued at USD 92.2 million by 2022, growing at the highest CAGR of 18.84% during the forecast period.

TABLE 38 LED LIGHTING MARKET FOR OTHER OUTDOOR LIGHTING APPLICATIONS, BY REGION, 2013–2022 (USD MILLION)

Region	2013	2014	2015	2016	2018	2020	2022	CAGR (2016–2022)
North America	15.4	18.7	22.0	25.2	31.1	38.0	47.0	10.98%
Europe	19.8	24.0	28.3	32.4	40.8	50.2	62.8	11.68%
APAC	29.4	35.4	42.0	48.5	64.5	84.3	107.0	14.11%
RoW	6.8	8.6	10.0	12.5	17.2	22.4	30.4	16.06%
Total	71.5	86.7	102.3	118.5	153.5	194.9	247.3	13.05%

Source: Experts' Interviews, Secondary Research, and MarketsandMarkets Analysis

The LED lighting market for other outdoor lighting end-use applications based on region was valued at USD 102.3 million in 2015 and is expected to reach USD 247.3 million by 2022, growing at a CAGR of 13.05% during the forecast period. The market in APAC was valued at USD 42.0 million in 2015 and is expected to reach USD 107.0 million by 2022, growing at a CAGR of 14.11% during the forecast period. The market in RoW is expected to be valued at USD 30.4 million by 2022, growing at the highest CAGR of 16.06% during the forecast period.

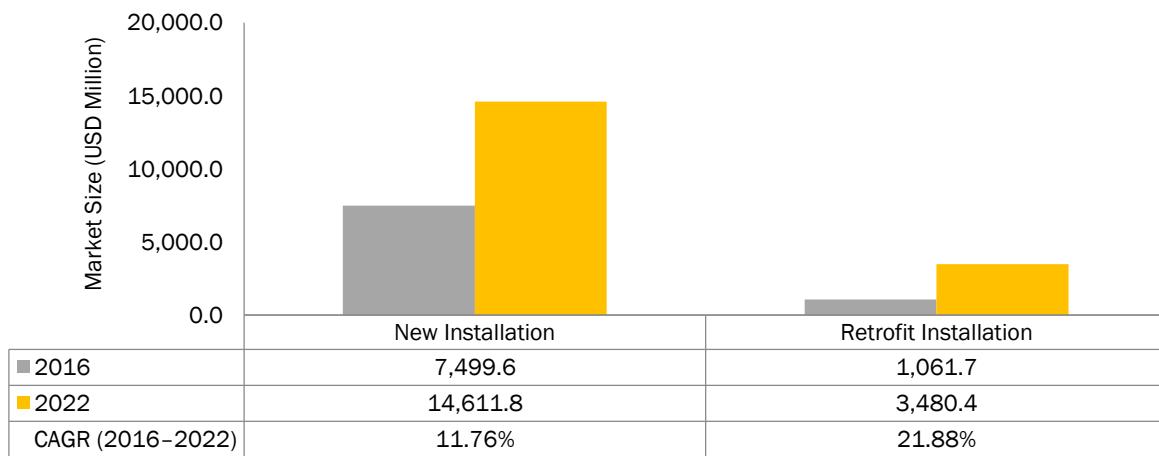
TABLE 39 LED LIGHTING MARKET FOR OUTDOOR LIGHTING APPLICATION, BY INSTALLATION TYPE, 2013–2022 (USD MILLION)

Installation Type	2013	2014	2015	2016	2018	2020	2022	CAGR (2016–2022)
New Installation	4,520.4	5,491.2	6,482.2	7,499.6	9,642.5	11,986.8	14,611.8	11.76%
Retrofit Installation	504.7	668.0	851.6	1,061.7	1,594.8	2,357.0	3,480.4	21.88%
Total	5,025.0	6,159.2	7,333.8	8,561.2	11,237.3	14,343.8	18,092.2	13.28%

Source: Experts' Interviews, Secondary Research, and MarketsandMarkets Analysis

The LED lighting market for outdoor lighting end-use application based on installation type was valued at USD 7,333.8 million in 2015 and is expected to reach USD 18,092.2 million by 2022, growing at a CAGR of 13.28% during the forecast period. The market for new installation was valued at USD 6,482.2 million in 2015 and is expected to reach USD 14,611.8 million by 2022, growing at a CAGR of 11.76% during the forecast period. The market for retrofit installation is expected to be valued at USD 3,480.4 million by 2022, growing at the highest CAGR of 21.88% during the forecast period.

FIGURE 39 LED LIGHTING MARKET FOR OUTDOOR LIGHTING APPLICATION, BY INSTALLATION TYPE (USD MILLION)



Source: Industry Journals, Experts' Interviews, and MarketsandMarkets Analysis

TABLE 40 LED LIGHTING MARKET FOR HIGHWAY AND ROADWAY OUTDOOR LIGHTING APPLICATION, BY INSTALLATION TYPE, 2013–2022 (USD MILLION)

Installation Type	2013	2014	2015	2016	2018	2020	2022	CAGR (2016–2022)
New Installation	1,804.2	2,217.1	2,646.5	3,094.8	4,060.8	5,144.9	6,384.1	12.83%
Retrofit Installation	320.1	426.9	548.5	689.2	1,052.5	1,583.8	2,387.7	23.01%
Total	2,124.3	2,644.0	3,195.0	3,784.0	5,113.4	6,728.7	8,771.8	15.04%

Source: Experts' Interviews, Secondary Research, and MarketsandMarkets Analysis

The LED lighting market for the highway and roadway outdoor lighting end-use application based on installation type was valued at USD 3,195.0 million in 2015 and is expected to reach USD 8,771.8 million

by 2022, growing at a CAGR of 15.04% during the forecast period. The market for new installation was valued at USD 2,646.5 million in 2015 and is expected to reach USD 6,384.1 million by 2022, growing at a CAGR of 12.83% during the forecast period. The market for retrofit installation is expected to be valued at USD 2,387.7 million by 2022, growing at the highest CAGR of 23.01% during the forecast period.

TABLE 41 LED LIGHTING MARKET FOR ARCHITECTURAL OUTDOOR LIGHTING APPLICATION, BY INSTALLATION TYPE, 2013–2022 (USD MILLION)

Installation Type	2013	2014	2015	2016	2018	2020	2022	CAGR (2016–2022)
New Installation	2,513.1	3,023.4	3,535.1	4,051.7	5,114.4	6,245.1	7,481.5	10.76%
Retrofit Installation	148.8	193.3	241.8	295.6	426.1	601.7	842.2	19.06%
Total	2,661.9	3,216.7	3,776.9	4,347.3	5,540.5	6,846.8	8,323.7	11.43%

Source: Experts' Interviews, Secondary Research, and MarketsandMarkets Analysis

The LED lighting market for the architectural outdoor lighting end-use application based on installation type was valued at USD 3,776.9 million in 2015 and is expected to reach USD 8,323.7 million by 2022, growing at a CAGR of 11.43% during the forecast period. The market for new installation was valued at USD 3,535.1 million in 2015 and is expected to reach USD 7,481.5 million by 2022, growing at a CAGR of 10.76% during the forecast period. The market for retrofit installation is expected to be valued at USD 842.2 million by 2022, growing at the highest CAGR of 19.06% during the forecast period.

TABLE 42 LED LIGHTING MARKET FOR PUBLIC PLACES OUTDOOR LIGHTING APPLICATION, BY INSTALLATION TYPE, 2013–2022 (USD MILLION)

Installation Type	2013	2014	2015	2016	2018	2020	2022	CAGR (2016–2022)
New Installation	140.4	175.6	213.2	253.3	342.4	445.5	566.3	14.35%
Retrofit Installation	26.9	36.0	46.3	58.1	87.5	127.9	183.1	21.08%
Total	167.3	211.7	259.5	311.4	429.9	573.4	749.4	15.76%

Source: Experts' Interviews, Secondary Research, and MarketsandMarkets Analysis

The LED lighting market for the public places outdoor lighting end-use application based on installation type was valued at USD 259.5 million in 2015 and is expected to reach USD 749.4 million by 2022, growing at a CAGR of 15.76% during the forecast period. The market for new installation was valued at USD 213.2 million in 2015 and is expected to reach USD 566.3 million by 2022, growing at a CAGR of 14.35% during the forecast period. The market for retrofit installation is expected to be valued at USD 183.1 million by 2022, growing at the highest CAGR of 21.08% during the forecast period.

TABLE 43 LED LIGHTING MARKET FOR OTHER OUTDOOR LIGHTING APPLICATIONS, BY INSTALLATION TYPE, 2013–2022 (USD MILLION)

Installation Type	2013	2014	2015	2016	2018	2020	2022	CAGR (2016–2022)
New Installation	62.7	75.1	87.4	99.8	124.9	151.3	179.9	10.32%
Retrofit Installation	8.8	11.7	14.9	18.7	28.6	43.6	67.4	23.83%
Total	71.5	86.7	102.3	118.5	153.5	194.9	247.3	13.05%

Source: Experts' Interviews, Secondary Research, and MarketsandMarkets Analysis

The LED lighting market for other outdoor lighting end-use applications based on installation type was valued at USD 102.3 million in 2015 and is expected to reach USD 247.3 million by 2022, growing at a CAGR of 13.05% during the forecast period. The market for new installation was valued at USD 87.4 million in 2015 and is expected to reach USD 179.9 million by 2022, growing at a CAGR of 10.32% during the forecast period. The market for retrofit installation is expected to be valued at USD 67.4 million by 2022, growing at the highest CAGR of 23.83% during the forecast period.

9 LED LIGHTING MARKET, BY PRODUCT TYPE

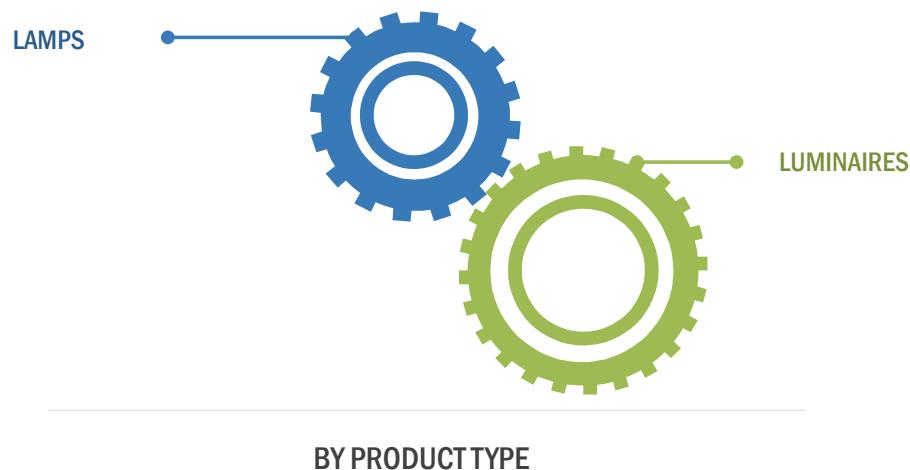
KEY FINDINGS

- The LED lighting market for lamps was valued at USD 25.72 billion in 2015 and is expected to reach USD 48.62 billion by 2022, growing at a CAGR of 9.00% during the forecast period.
- The market for luminaires is expected to be valued at USD 43.77 billion by 2022, growing at the highest CAGR of 21.13% during the forecast period.
- Shipment for the luminaires segment is expected to reach 8.78 billion units by 2022, at the highest CAGR of 29.31% during the forecast period.
- The LED lighting market for lamps based on new installation type is expected to be valued at USD 41.57 billion by 2022, growing at the highest CAGR of 9.06% during the forecast period.
- The market for luminaires based on retrofit installation type registered the highest shipment of 887.8 million units in 2015 and is expected to reach 6,587.0 million units by 2022, at a CAGR of 32.56% during the forecast period.

9.1 INTRODUCTION

The LED lighting market has been segmented on the basis of product type into lamps and luminaires.

FIGURE 40 LED LIGHTING MARKET, BY PRODUCT TYPE



Source: Lighting Controls Association (U.S.), National Electrical Manufacturers Association (NEMA, U.S.), Industry Journals, Experts' Interviews, and MarketsandMarkets Analysis.

TABLE 44 LED LIGHTING MARKET, BY PRODUCT TYPE, 2013–2022 (USD MILLION)

Product Type	2013	2014	2015	2016	2018	2020	2022	CAGR (2016–2022)
Lamps	19,063.9	22,413.7	25,723.4	29,002.9	35,512.2	42,026.6	48,629.9	9.00%
Luminaires	6,158.2	8,485.8	11,028.5	13,861.7	20,791.5	30,283.2	43,776.2	21.13%
Total	25,222.1	30,899.5	36,751.9	42,864.5	56,303.7	72,309.8	92,406.1	13.66%

Source: Experts' Interviews, Secondary Research, and MarketsandMarkets Analysis

The LED lighting market based on product type was valued at USD 36,751.9 million in 2015 and is expected to reach USD 92,406.1 million by 2022, growing at a CAGR of 13.66% during the forecast period. The market for lamps was valued at USD 25,723.4 million in 2015 and is expected to reach USD 48,629.9 million by 2022, growing at a CAGR of 9.00% during the forecast period. The market for luminaires is expected to be valued at USD 43,776.2 million by 2022, growing at the highest CAGR of 21.13% during the forecast period. The lamps subsegment is expected to be the dominant market as it is the major light source and main component of an LED lighting system.

TABLE 45 LED LIGHTING MARKET, BY PRODUCT TYPE, 2013–2022 (MILLION UNITS)

Product Type	2013	2014	2015	2016	2018	2020	2022	CAGR (2016–2022)
Lamps	1,532.0	1,848.8	2,181.9	2,533.8	3,305.1	4,190.0	5,224.2	12.82%
Luminaires	705.9	1,029.8	1,414.3	1,880.0	3,173.7	5,263.7	8,789.6	29.31%
Total	2,237.9	2,878.6	3,596.3	4,413.9	6,478.9	9,453.7	14,013.8	21.23%

Source: Experts' Interviews, Secondary Research, and MarketsandMarkets Analysis

The LED lighting market based on product type registered a shipment of 3,596.3 million units in 2015 and is expected to reach 14,013.8 million units by 2022, at a CAGR of 21.23% during the forecast period. The lamps segment registered the highest shipment of 2,181.9 million units in 2015 and is expected to reach 5,224.2 million units by 2022, at a CAGR of 12.82% during the forecast period. However, shipment for the luminaires segment is expected to reach 8,789.6 million units by 2022, at the highest CAGR of 29.31% during the forecast period. The market for luminaires is expected to witness high growth owing to the increasing importance of lighting controls in the LED lighting ecosystem.

9.2 LAMPS

Light-emitting diodes (LEDs) are semiconductors that convert electricity into light through the movement of electrons. The earlier applications of LEDs included indicators on hi-fi systems, standby lights on televisions, indicators for operation on adaptors, and other electronic equipment. LED has now evolved as a major lighting technology with a longer life, greater durability, flexibility, energy efficiency, and nontoxicity compared to other lighting solutions. LEDs include miniature LEDs, high-brightness LEDs, and ultraviolet LEDs. Blue and white LEDs are more expensive than red, orange, amber, yellow, white, and green ones.

LEDs are different from conventional light sources in terms of optical behavior where they emit light in an omnidirectional manner and require a reflector to shape the radiation. LED point sources radiate in one hemisphere and often require the use of collimators in the form of total internal reflection (TIR) lenses to steer the beam. Given the layered structure of an LED chip and its in-built primary optics, the emission of light is always Lambertian in nature. This basic emission is also influenced by additional optical means that are integrated into the LED—mostly features a reduced beam angle. Optic control is usually applied with collimator lenses and reflectors—bulk optics that implement TIR.

TABLE 46 LED LIGHTING MARKET FOR LAMPS, BY INSTALLATION TYPE, 2013–2022 (USD MILLION)

Installation Type	2013	2014	2015	2016	2018	2020	2022	CAGR (2016–2022)
New Installation	16,110.2	19,009.6	21,870.7	24,702.2	30,312.1	35,912.6	41,575.5	9.06%
Retrofit Installation	2,953.7	3,404.1	3,852.7	4,300.7	5,200.1	6,114.0	7,054.4	8.60%
Total	19,063.9	22,413.7	25,723.4	29,002.9	35,512.2	42,026.6	48,629.9	9.00%

Source: Experts' Interviews, Secondary Research, and MarketsandMarkets Analysis

The LED lighting market for lamps based on installation type was valued at USD 25,723.4 million in 2015 and is expected to reach USD 48,629.9 million by 2022, growing at a CAGR of 9.00% during the forecast period. The market for new installation was valued at USD 21,870.7 million in 2015 and is expected to reach USD 41,575.5 million by 2022, growing at the highest CAGR of 9.06% during the forecast period.

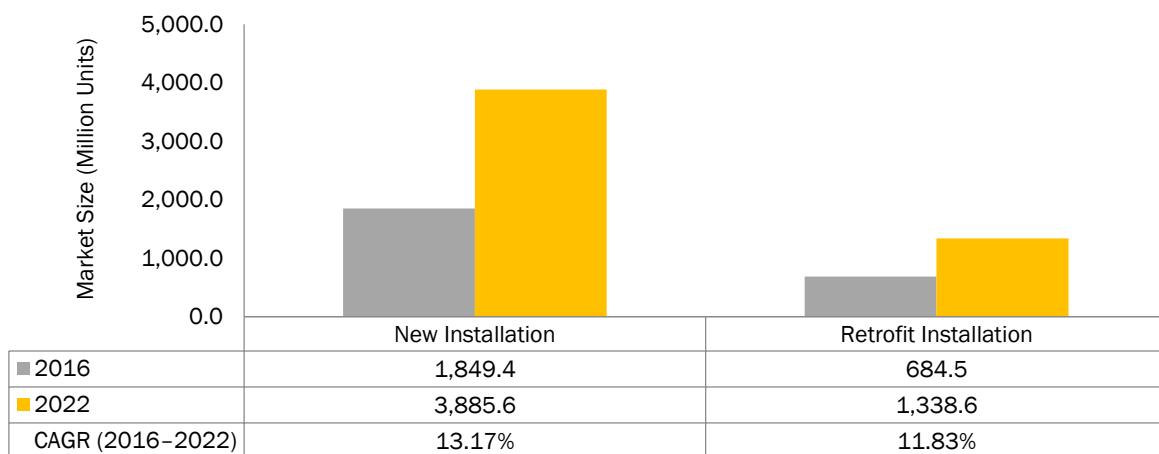
TABLE 47 LED LIGHTING MARKET FOR LAMPS, BY INSTALLATION TYPE, 2013–2022 (MILLION UNITS)

Installation Type	2013	2014	2015	2016	2018	2020	2022	CAGR (2016–2022)
New Installation	1,097.0	1,334.7	1,584.8	1,849.4	2,430.5	3,099.7	3,885.6	13.17%
Retrofit Installation	435.0	514.1	597.1	684.5	874.6	1,090.3	1,338.6	11.83%
Total	1,532.0	1,848.8	2,181.9	2,533.8	3,305.1	4,190.0	5,224.2	12.82%

Source: Experts' Interviews, Secondary Research, and MarketsandMarkets Analysis

The LED lighting market for lamps based on installation type registered a shipment of 2,181.9 million units in 2015 and is expected to reach 5,224.2 million units by 2022, at a CAGR of 12.82% during the forecast period. The new installation segment registered the highest shipment of 1,584.8 million units in 2015 and is expected to reach 3,885.6 million units by 2022, at the highest CAGR of 13.17% during the forecast period.

FIGURE 41 LED LIGHTING MARKET FOR LAMPS, BY INSTALLATION TYPE (MILLION UNITS)



Source: Industry Journals, Experts' Interviews, and MarketsandMarkets Analysis.

9.3 LUMINAIRES

Luminaires refer to light modules or light engines and drivers which are combined with additional optics, heat sinks, and protective cases to form a complete lighting system. The fixture helps to optimize the optics and also operates as a heat sink. Lighting fixture and luminaire are used synonymously.

TABLE 48 LED LIGHTING MARKET FOR LUMINAIRES, BY INSTALLATION TYPE, 2013–2022 (USD MILLION)

Installation Type	2013	2014	2015	2016	2018	2020	2022	CAGR (2016–2022)
New Installation	3,485.0	4,577.5	5,721.7	6,934.6	9,646.6	12,896.8	16,901.2	16.01%
Retrofit Installation	2,673.2	3,908.4	5,306.8	6,927.1	11,144.9	17,386.4	26,875.0	25.35%
Total	6,158.2	8,485.8	11,028.5	13,861.7	20,791.5	30,283.2	43,776.2	21.13%

Source: Experts' Interviews, Secondary Research, and MarketsandMarkets Analysis

The LED lighting market for luminaires based on installation type was valued at USD 11,028.5 million in 2015 and is expected to reach USD 43,776.2 million by 2022, growing at a CAGR of 21.13% during the forecast period. The market for new installation was valued at USD 5,721.7 million in 2015 and is expected to reach USD 16,901.2 million by 2022, growing at a CAGR of 16.01% during the forecast period. The market for retrofit installation is expected to be valued at USD 26,875.0 million by 2022, growing at the highest CAGR of 25.35% during the forecast period.

TABLE 49 LED LIGHTING MARKET FOR LUMINAIRES, BY INSTALLATION TYPE, 2013–2022 (MILLION UNITS)

Installation Type	2013	2014	2015	2016	2018	2020	2022	CAGR (2016–2022)
New Installation	295.9	404.3	526.6	666.2	1,015.7	1,502.2	2,202.6	22.06%
Retrofit Installation	410.0	625.4	887.8	1,213.9	2,158.0	3,761.5	6,587.0	32.56%
Total	705.9	1,029.8	1,414.3	1,880.0	3,173.7	5,263.7	8,789.6	29.31%

Source: Experts' Interviews, Secondary Research, and MarketsandMarkets Analysis

The LED lighting market for luminaires based on installation type registered a shipment of 1,414.3 million units in 2015 and is expected to reach 8,789.6 million units by 2022, at a CAGR of 29.31% during the forecast period. The retrofit installation segment registered the highest shipment of 887.8 million units in 2015 and is expected to reach 6,587.0 million units by 2022, at the highest CAGR of 32.56% during the forecast period.

10 GEOGRAPHIC ANALYSIS

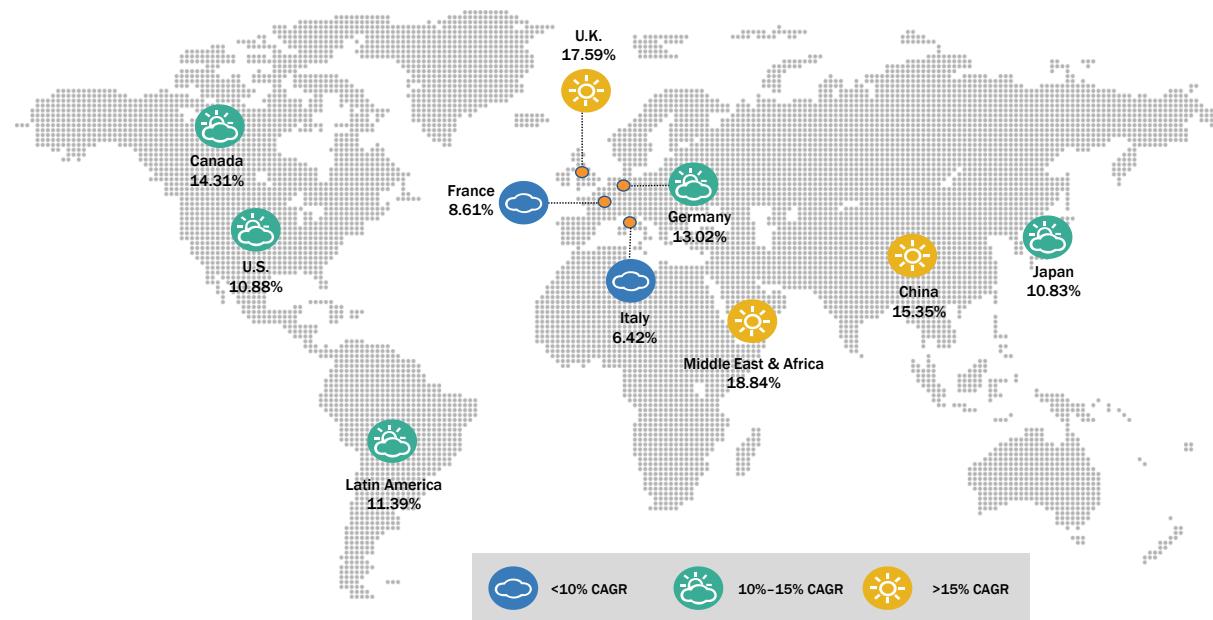
KEY FINDINGS

- The LED lighting market in Asia-Pacific was valued at USD 15.08 billion in 2015 and is expected to reach USD 39.99 billion by 2022, at a CAGR of 14.72% during the forecast period.
- The LED lighting market in the RoW region is expected to be valued at USD 11.36 billion by 2022, growing at the highest CAGR of 16.68% during the forecast period.
- The LED lighting market in North America for the indoor lighting application is expected to be worth USD 14.13 billion by 2022, growing at the highest CAGR of 11.67% during the forecast period.
- The LED lighting market in Europe for the new installation segment was valued at USD 7.02 billion in 2015 and is expected to reach USD 13.57 billion by 2022, at a CAGR of 9.34% during the forecast period.
- The LED lighting market in China was valued at USD 6.52 billion in 2015 and is expected to reach USD 17.96 billion by 2022, at a CAGR of 15.35% during the forecast period.

10.1 INTRODUCTION

The LED lighting market has been segmented on the basis of geographical regions into North America, Europe, Asia-Pacific (APAC), and Rest of the World (RoW). The countries considered under North America are the U.S. and Canada. The market in Europe has been further segmented into Germany, France, the U.K., Italy, and Rest of Europe. The market in Asia-Pacific has been subsegmented into China, Japan, and Rest of APAC. The RoW region is further divided into the Middle East & Africa and Latin America which includes Mexico, Brazil, and Argentina.

FIGURE 42 GEOGRAPHIC SNAPSHOT OF THE LED LIGHTING MARKET



Source: Experts' Interviews, Secondary Research, and MarketsandMarkets Analysis

TABLE 50 LED LIGHTING MARKET, BY REGION, 2013–2022 (USD MILLION)

Region	2013	2014	2015	2016	2018	2020	2022	CAGR (2016–2022)
North America	5,450.7	6,667.8	7,912.9	9,107.8	11,400.0	14,091.4	17,575.8	11.58%
Europe	7,004.5	8,565.7	10,157.1	11,710.2	14,960.7	18,621.1	23,468.3	12.28%
APAC	10,362.4	12,606.8	15,089.9	17,541.7	23,637.3	31,293.2	39,994.4	14.72%
RoW	2,404.5	3,059.3	3,592.1	4,504.9	6,305.7	8,304.1	11,367.5	16.68%
Total	25,222.1	30,899.5	36,751.9	42,864.5	56,303.7	72,309.8	92,406.1	13.66%

Source: Experts' Interviews, Secondary Research, and MarketsandMarkets Analysis

The LED lighting market segmented on the basis of region was valued at USD 36,751.9 million in 2015 and is expected to reach USD 92,406.1 million by 2022, at a CAGR of 13.66% during the forecast period. The LED lighting market in APAC was valued at USD 15,089.9 million in 2015 and is expected to reach USD 39,994.4 million by 2022, at a CAGR of 14.72% during the forecast period. The market in the RoW region is expected to be valued at USD 11,367.5 million by 2022, growing at the highest CAGR of 16.68% during the forecast period. The countries in the RoW region are likely to witness the extensive growth in infrastructural building projects in the field of real estate and the energy sector. Therefore, the market in this region is expected to exhibit high growth.

TABLE 51 LED LIGHTING MARKET, BY REGION, 2013–2022 (MILLION UNITS)

Region	2013	2014	2015	2016	2018	2020	2022	CAGR (2016–2022)
North America	483.6	621.2	774.3	937.8	1,311.8	1,842.3	2,665.4	19.02%
Europe	621.5	798.0	993.9	1,205.8	1,721.5	2,434.5	3,559.1	19.77%
APAC	919.4	1,174.4	1,476.6	1,806.3	2,719.9	4,091.2	6,065.3	22.37%
RoW	213.3	285.0	351.5	463.9	725.6	1,085.7	1,723.9	24.46%
Total	2,237.9	2,878.6	3,596.3	4,413.9	6,478.9	9,453.7	14,013.8	21.23%

Source: Experts' Interviews, Secondary Research, and MarketsandMarkets Analysis

The LED lighting market segmented on the basis of region registered a shipment of 3,596.3 million units in 2015 and is expected to witness a shipment of 14,013.8 million units by 2022, at a CAGR of 21.23% during the forecast period. The market in APAC registered the largest shipment of 1,476.6 million units in 2015 and is expected to reach 6,065.3 million units by 2022, at a CAGR of 22.37% during the forecast period. A sizeable portion of LED displays are produced in the APAC region, especially in China, which is why the market in this region is expected to register the largest shipment of LED lighting products/systems. However, the market in the RoW region is expected to grow at the highest CAGR of 24.46% during the forecast period.

10.2 NORTH AMERICA

The North American market has been segmented into the U.S. and Canada. Presently, the U.S. dominates the LED lighting market in North America despite an uneven economic recovery in the U.S. The adoption of LED lighting in Canada is expected to grow at a higher rate than that of the U.S. in the near future.

There are major companies in the U.S. developing LED lighting systems such as General Electric and Cree, Inc. These systems are majorly deployed for the commercial and industrial applications of lighting. According to the U.S. Department of Energy, only 7% of the buildings in the U.S. had lighting controls in 2012. This indicates that companies manufacturing LED lighting systems are likely to have a fierce competition to deliver interoperable lighting control products. Additionally, most of the companies that have developed lighting-specific control technology are in this industry for less than three years. The market in this region is at the maturity stage and currently holds a substantial size for the LED lighting market.

10.2.1 U.S.

The U.S. is expected to remain the largest market for LED lighting in North America, despite an uneven economic recovery which includes increasing GDP growth but low wage rates.

10.2.1.1 **Building codes expected to boost the adoption of new technologies in light switches**

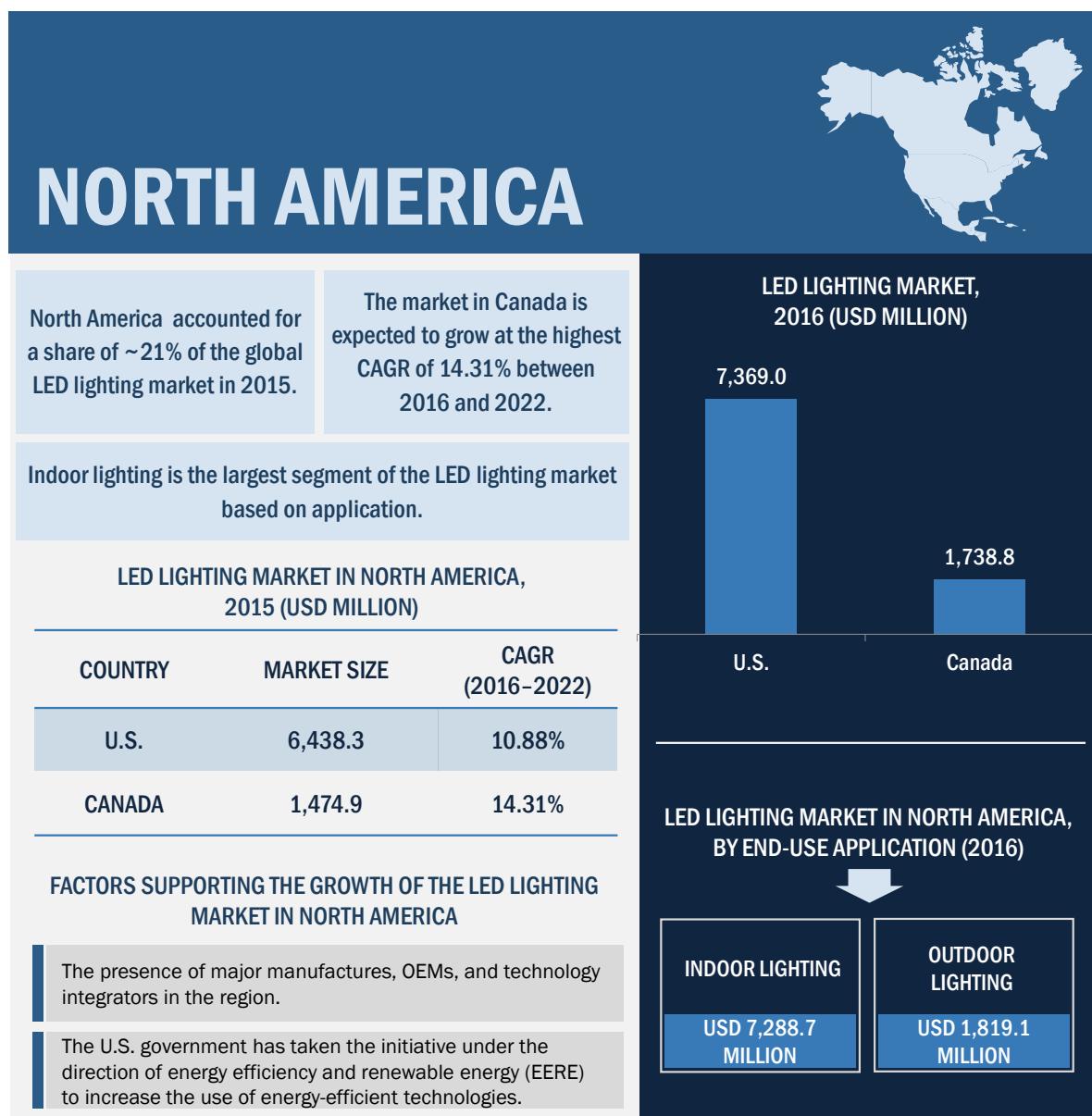
The building codes in the U.S. are increasingly being designed to create energy-efficient building systems. According to the U.S. Department of Energy, lighting contributes to almost 20% of the overall energy consumption. The number of lighting system designers adopting sensors and dimmers in their lighting design for buildings is increasing to comply with these building codes, which is driving the growing smart lighting segment of the LED lighting market in the U.S.

10.2.2 CANADA

Canada is also the major market for LED lighting in North America after the U.S. The adoption rate of LED lighting systems is high in this country because of the growing consumer awareness regarding energy-efficient systems and a relatively stable economy.

10.2.2.1 **Growing adoption of LED lighting systems**

Contractors and home owners are expected to adopt more energy-efficient lighting systems in the near future, owing to a variety of factors which include the steady decrease in the price of LEDs. Other factors include consumers' desire to integrate wireless lighting control and preference for high-quality LED lights or other energy-efficient light sources such as CFL.

FIGURE 43 SNAPSHOT OF THE LED LIGHTING MARKET IN NORTH AMERICA

Source: Experts' Interviews, Secondary Research, and MarketsandMarkets Analysis

TABLE 52 LED LIGHTING MARKET IN NORTH AMERICA, BY END-USE APPLICATION, 2013–2022 (USD MILLION)

End-Use Application	2013	2014	2015	2016	2018	2020	2022	CAGR (2016–2022)
Indoor Lighting	4,364.8	5,338.7	6,333.9	7,288.7	9,124.8	11,296.2	14,134.7	11.67%
Outdoor Lighting	1,086.0	1,329.1	1,579.0	1,819.1	2,275.3	2,795.3	3,441.2	11.21%
Total	5,450.7	6,667.8	7,912.9	9,107.8	11,400.0	14,091.4	17,575.8	11.58%

Source: Experts' Interviews, Secondary Research, and MarketsandMarkets Analysis

The Led lighting market in North America based on end-use application was valued at USD 7,912.9 million in 2015 and is expected to reach USD 17,575.8 million by 2022, at a CAGR of 11.58% during the forecast period. The market for indoor lighting application was valued at USD 6,333.9 million in 2015 and is expected to reach USD 14,134.7 million by 2022, at a CAGR of 11.67% during the forecast period. The market for indoor lighting application is expected to be worth USD 14,134.7 million by 2022, growing at a higher CAGR of 11.67% during the forecast period. The region, being home to some of the most developed nations in the world, is also home to some of the most affluent population. They are increasingly focusing on building smart homes in which LED lights are used and is the main reason for the indoor lighting segment to be leading the market in the region.

TABLE 53 LED LIGHTING MARKET IN NORTH AMERICA FOR INDOOR LIGHTING, BY TYPE, 2013–2022 (USD MILLION)

Type	2013	2014	2015	2016	2018	2020	2022	CAGR (2016–2022)
Residential	2,357.9	2,856.3	3,355.3	3,821.8	4,681.6	5,658.6	6,891.2	10.32%
Commercial	1,808.4	2,225.2	2,655.8	3,074.2	3,893.6	4,874.4	6,162.8	12.29%
Industrial	150.9	190.8	234.3	279.7	379.6	517.3	728.4	17.30%
Others	47.6	66.4	88.4	113.0	169.9	245.9	352.2	20.86%
Total	4,364.8	5,338.7	6,333.9	7,288.7	9,124.8	11,296.2	14,134.7	11.67%

Note: Other indoor lighting application includes government and public buildings.

Source: Experts' Interviews, Secondary Research, and MarketsandMarkets Analysis

The LED lighting market in North America for indoor lighting was valued at USD 6,333.9 million in 2015 and is expected to reach USD 14,134.7 million by 2022, at a CAGR of 11.67% during the forecast period. The market for the residential application was valued at USD 3,355.3 million in 2015 and is expected to reach USD 6,891.2 million by 2022, at a CAGR of 10.32% during the forecast period. The market for others applications is expected to be valued at USD 352.2 million by 2022, at the highest CAGR of 20.86% during the forecast period.

TABLE 54 LED LIGHTING MARKET IN NORTH AMERICA FOR OUTDOOR LIGHTING, BY TYPE, 2013–2022 (USD MILLION)

Type	2013	2014	2015	2016	2018	2020	2022	CAGR (2016–2022)
Highway & Roadway	459.1	570.6	687.9	804.0	1,035.3	1,311.3	1,668.4	12.94%
Architectural	575.3	694.1	813.2	923.7	1,121.8	1,334.3	1,583.2	9.40%
Public Places	36.2	45.7	55.9	66.2	87.0	111.7	142.5	13.64%
Others	15.4	18.7	22.0	25.2	31.1	38.0	47.0	10.98%
Total	1,086.0	1,329.1	1,579.0	1,819.1	2,275.3	2,795.3	3,441.2	11.21%

Note: other outdoor lighting applications include rail lines and harbors.

Source: Experts' Interviews, Secondary Research, and MarketsandMarkets Analysis

The LED lighting market in North America for outdoor lighting was valued at USD 1,579.0 million in 2015 and is expected to reach USD 3,441.2 million by 2022, at a CAGR of 11.21% during the forecast period. The market for the architectural application was valued at USD 813.2 million in 2015 and is expected to reach USD 1,583.2 million by 2022, at a CAGR of 9.4% during the forecast period. The market for the

public places segment is expected to be valued at USD 142.5 million by 2022, growing at the highest CAGR of 13.64% during the forecast period.

TABLE 55 LED LIGHTING MARKET IN NORTH AMERICA, BY INSTALLATION TYPE, 2013–2022 (USD MILLION)

Installation Type	2013	2014	2015	2016	2018	2020	2022	CAGR (2016–2022)
New Installation	3,896.8	4,661.8	5,405.1	6,084.1	7,263.1	8,388.9	9,648.1	7.99%
Retrofit Installation	1,553.9	2,006.0	2,507.8	3,023.7	4,136.9	5,702.6	7,927.7	17.43%
Total	5,450.7	6,667.8	7,912.9	9,107.8	11,400.0	14,091.4	17,575.8	11.58%

Source: Experts' Interviews, Secondary Research, and MarketsandMarkets Analysis

The LED lighting market in North America based on installation type was valued at USD 7,912.9 million in 2015 and is expected to reach USD 17,575.8 million by 2022, at a CAGR of 11.58% during the forecast period. The LED lighting market for the new installation segment was valued at USD 5,405.1 million in 2015 and is expected to reach USD 9,648.1 million by 2022, at a CAGR of 7.99% during the forecast period. The market for the retrofit installation segment is expected to be valued at USD 7,927.7 million by 2022, at a higher CAGR of 17.43% during the forecast period.

TABLE 56 LED LIGHTING MARKET IN NORTH AMERICA, BY COUNTRY, 2013–2022 (USD MILLION)

Country	2013	2014	2015	2016	2018	2020	2022	CAGR (2016–2022)
U.S.	4,526.8	5,520.9	6,438.3	7,369.0	9,131.0	11,167.0	13,696.5	10.88%
Canada	923.9	1,146.9	1,474.9	1,738.8	2,269.1	2,924.4	3,879.3	14.31%
Total	5,450.7	6,667.8	7,913.2	9,107.8	11,400.0	14,091.4	17,575.8	11.58%

Source: Experts' Interviews, Secondary Research, and MarketsandMarkets Analysis

The LED lighting market for North America, by country was valued at USD 7,913.2 million in 2015 and is expected to reach USD 17,575.8 million by 2022, at a CAGR of 11.58% during the forecast period. The U.S. market was valued at USD 6,438.3 million in 2015 and is expected to reach USD 13,696.5 million by 2022, at a CAGR of 10.88% during the forecast period. The Canada market is expected to reach USD 3,879.3 million by 2022, at the highest CAGR of 14.31% during the forecast period.

10.3 EUROPE

Europe is one of the major regions wherein LED lighting has been accepted and adopted and is home to major players such as Cooper Industries, Inc. (Ireland), Zumtobel Group (Austria) and lighting component manufacturers such as OSRAM (Germany) and Philips Lighting Holding B.V. (Netherlands).

The U.K. and Germany are expected to hold a major share of the LED lighting market for the residential application. The standard of living is very high in these countries, and taking the high GDP per capita rates into account, a large section of the population can afford energy-efficient lighting systems in their homes. The significant market share in the region is also attributed to the increasing awareness about energy conservation and implementation of various government initiatives toward the same. The environmental policies of the European Union, such as the 2012 Energy Efficiency Directive and Energy Performance of Building Directive (EPBD) of the European real estate sector, help to establish and promote energy conservation measures across all sectors such as industrial and commercial workplaces as well as homes.

There has been a marked improvement in construction activity in western European countries, owing to the recovering of the economy from recession and the Eurozone crisis. After the slump in new housing and commercial construction, there has been a significant growth in new housing and construction in 2015 and the trend is expected to continue. The increase in construction activities drives the market for LED lighting because of high rate of new installations of lighting fixtures and lamps.

10.3.1 U.K.

10.3.1.1 Demand for energy-saving and long-lasting lighting systems driving the market in the U.K.

LED lighting plays an important role in the lighting manufacturing industry. The factors driving this market include the rising demand for energy conservation and lighting systems with a long shelf life. The presence of the Lighting Industry Association is expected to strengthen the industry by promoting the benefits of sustainability in lighting and good-quality lighting in the U.K.

10.3.2 GERMANY

10.3.2.1 High demand for smart homes driving the LED lighting market in Germany

Germany is Europe's economic powerhouse and plays a crucial role in the European market for LED lighting. There is a preference for well-equipped smart homes in Germany. Moreover, in the next four to five years, the number of new households is expected to rise, which offers potential opportunities for new and innovative lighting solutions. OSRAM is one of the major lighting control providers having a presence in this country.

10.3.3 FRANCE

10.3.3.1 Growing awareness toward energy conservation

The LED lighting market is creating a lot of opportunities in France, given the growing awareness toward energy saving. For instance, the BBC Standard (France) has set strict energy consumption targets, that is, 50kWh/m²/year.

10.3.4 ITALY

10.3.4.1 High demand from the rebounding construction sector

Italy is a growing market for LED lighting. The construction industry in this country is recovering from the sovereign debt crisis, and this is expected to boost the LED lighting market in the country.

10.3.5 REST OF EUROPE

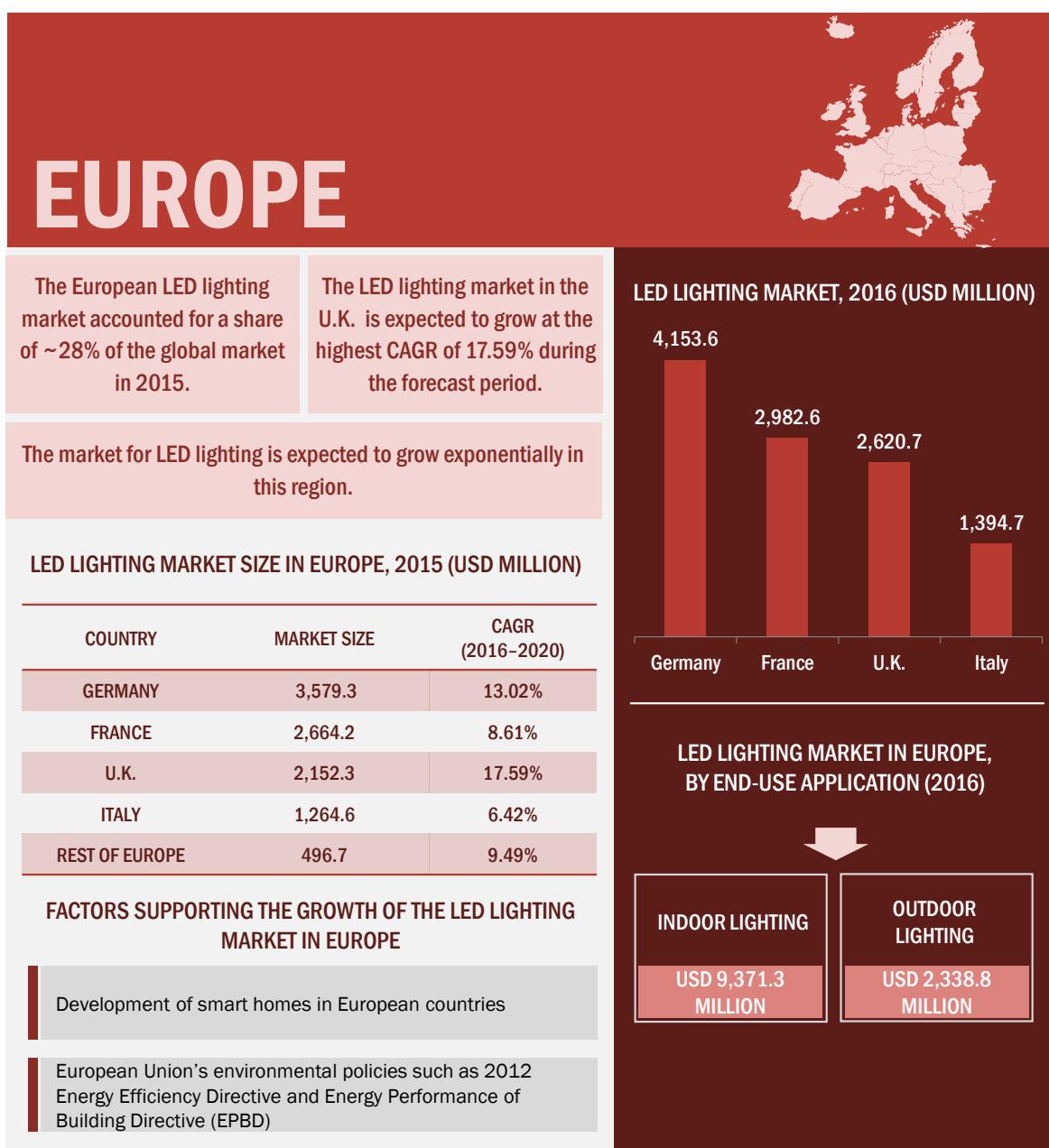
10.3.5.1 Increasing investments to fuel the growth of this market in the future

The European market is further divided into Rest of Europe. Europe is a major market for LED lighting due to the affluence of its consumers and the competitiveness of the market, along with the presence of global consumer electronics companies. The countries covered in Rest of Europe are expected to witness growth in the near future due to huge investments.

10.3.5.2 Spain

10.3.5.2.1 Government regulations for reducing emissions driving the adoption of intelligent lighting

Spain is also recovering from the sovereign debt crisis like Italy, which impacted its housing and construction industry adversely. A rebound in the construction activity is expected during the forecast period. Similar to other European Union members, Spain is also bound to reduce its greenhouse emissions. Hence, regulatory authorities are focusing on facilitating the use of lighting controls such as LED lighting to make the overall lighting efficient.

FIGURE 44 SNAPSHOT OF THE LED LIGHTING MARKET IN EUROPE


Source: Experts' Interviews, Secondary Research, and MarketsandMarkets Analysis

TABLE 57 LED LIGHTING MARKET OF EUROPE, BY END-USE APPLICATION, 2013–2022 (USD MILLION)

End-Use Application	2013	2014	2015	2016	2018	2020	2022	CAGR (2016–2022)
Indoor Lighting	5,609.0	6,858.3	8,130.2	9,371.3	11,974.8	14,927.3	18,873.4	12.38%
Outdoor Lighting	1,395.5	1,707.4	2,026.8	2,338.8	2,985.9	3,693.8	4,594.9	11.91%
Total	7,004.5	8,565.7	10,157.1	11,710.2	14,960.7	18,621.1	23,468.3	12.28%

Source: Experts' Interviews, Secondary Research, and MarketsandMarkets Analysis

The LED lighting market in Europe based on end-use application was valued at USD 10,157.1 million in 2015 and is expected to reach USD 23,468.3 million by 2022, at a CAGR of 12.28% during the forecast period. The market for the indoor lighting application was valued at USD 8,130.2 million in 2015 and is expected to reach USD 18,873.4 million by 2022, at a CAGR of 12.38% during the forecast period. The market for indoor lighting application is expected to be worth USD 18,873.4 million by 2022, at the highest CAGR of 12.38% during the forecast period.

TABLE 58 LED LIGHTING MARKET IN EUROPE FOR INDOOR LIGHTING, BY TYPE, 2013–2022 (USD MILLION)

Type	2013	2014	2015	2016	2018	2020	2022	CAGR (2016–2022)
Residential	3,030.0	3,669.4	4,306.9	4,913.8	6,143.8	7,477.5	9,201.6	11.02%
Commercial	2,323.8	2,858.6	3,409.0	3,952.6	5,109.7	6,441.2	8,228.9	13.00%
Industrial	193.9	245.1	300.8	359.6	498.2	683.6	972.6	18.04%
Others	61.2	85.3	113.5	145.3	223.0	324.9	470.3	21.62%
Total	5,609.0	6,858.3	8,130.2	9,371.3	11,974.8	14,927.3	18,873.4	12.38%

Source: Experts' Interviews, Secondary Research, and MarketsandMarkets Analysis

The LED lighting market in Europe for indoor lighting was valued at USD 8,130.2 million in 2015 and is expected to reach USD 18,873.4 million by 2022, at a CAGR of 12.38% during the forecast period. The market for the residential application was valued at USD 4,306.9 million in 2015 and is expected to reach USD 9,201.6 million by 2022, at a CAGR of 11.02% during the forecast period. The market for other indoor applications is expected to be valued at USD 470.3 million by 2022, growing at the highest CAGR of 21.62% during the forecast period.

TABLE 59 LED LIGHTING MARKET IN EUROPE FOR OUTDOOR LIGHTING, BY TYPE, 2013–2022 (USD MILLION)

Type	2013	2014	2015	2016	2018	2020	2022	CAGR (2016–2022)
Highway & Roadway	589.9	733.0	883.0	1,033.8	1,358.7	1,732.8	2,227.8	13.65%
Architectural	739.2	891.7	1,043.8	1,187.6	1,472.2	1,763.2	2,114.0	10.09%
Public Places	46.5	58.7	71.7	85.1	114.2	147.7	190.3	14.36%
Others	19.8	24.0	28.3	32.4	40.8	50.2	62.8	11.68%
Total	1,395.5	1,707.4	2,026.8	2,338.8	2,985.9	3,693.8	4,594.9	11.91%

Source: Experts' Interviews, Secondary Research, and MarketsandMarkets Analysis

The LED lighting market in Europe for outdoor lighting was valued at USD 2,026.8 million in 2015 and is expected to reach USD 4,594.9 million by 2022, at a CAGR of 11.91% during the forecast period. The market for the architectural application was valued at USD 1,043.8 million in 2015 and is expected to reach USD 2,114.0 million by 2022, at a CAGR of 10.09% during the forecast period. The market for the public places segment is expected to be worth USD 190.3 million by 2022, growing at the highest CAGR of 14.36% during the forecast period.

TABLE 60 LED LIGHTING MARKET IN EUROPE, BY INSTALLATION TYPE, 2013–2022 (USD MILLION)

Installation Type	2013	2014	2015	2016	2018	2020	2022	CAGR (2016–2022)
New Installation	5,030.8	6,044.2	7,028.3	7,946.2	9,764.4	11,523.0	13,575.5	9.34%
Retrofit Installation	1,973.7	2,521.4	3,128.8	3,764.0	5,196.3	7,098.1	9,892.8	17.47%
Total	7,004.5	8,565.7	10,157.1	11,710.2	14,960.7	18,621.1	23,468.3	12.28%

Source: Experts' Interviews, Secondary Research, and MarketsandMarkets Analysis

The LED lighting market in Europe based on installation type was valued at USD 10,157.1 million in 2015 and is expected to reach USD 23,468.3 million by 2022, at a CAGR of 12.28% during the forecast period. The market for the new installation segment was valued at USD 7,028.3 million in 2015 and is expected to reach USD 13,575.5 million by 2022, at a CAGR of 9.34% during the forecast period. The market for the retrofit installation segment is expected to be valued at USD 9,892.8 million by 2022, growing at the highest CAGR of 17.47% during the forecast period.

TABLE 61 LED LIGHTING MARKET IN EUROPE, BY COUNTRY, 2013–2022 (USD MILLION)

Country	2013	2014	2015	2016	2018	2020	2022	CAGR (2016–2022)
Germany	2,434.8	2,998.0	3,579.3	4,153.6	5,376.9	6,779.9	8,657.5	13.02%
France	1,945.1	2,312.7	2,664.2	2,982.6	3,580.1	4,171.1	4,895.5	8.61%
U.K.	1,317.5	1,713.1	2,152.3	2,620.7	3,704.3	5,053.8	6,927.8	17.59%
Italy	949.1	1,113.5	1,264.6	1,394.7	1,618.7	1,810.0	2,025.3	6.42%
Rest of Europe	357.9	428.3	496.7	558.6	680.7	806.3	962.2	9.49%
Total	7,004.5	8,565.7	10,157.1	11,710.2	14,960.7	18,621.1	23,468.3	12.28%

Source: Experts' Interviews, Secondary Research, and MarketsandMarkets Analysis

The LED lighting market in Europe was valued at USD 10,157.1 million in 2015 and is expected to reach USD 23,468.3 million by 2022, at a CAGR of 12.28% during the forecast period. The German market was valued at USD 3,579.3 million in 2015 and is expected to reach USD 8,657.5 million by 2022, at a CAGR of 13.02% during the forecast period. Focus on installing LED lights for highway lighting to promote trans-European trade by the German authorities is the reason for Germany to hold the largest market in Europe during the forecast period. The market in the U.K. is expected to be valued at USD 6,927.8 million by 2022, growing at the highest CAGR of 17.59% during the forecast period.

10.4 ASIA-PACIFIC

Asia-Pacific is expected to be one of the fastest-growing markets for LED lighting during the forecast period. The LED lighting market has a huge potential in the APAC region, and it is expected that the lighting systems would be accepted by consumers as an integral part of a digitalized household. The increased construction activities in Asia-Pacific are contributing significantly to the growth of the LED lighting market in the region. There are several new opportunities for energy-efficient lighting in the next few years as around 200 million homes are expected to be constructed in China and 18 million homes in India. The emerging economies of China and India are also impacting the overall market significantly. However, the main restraints for the LED lighting market in China and other APAC countries are the high installation cost of energy-efficient lighting systems and lack of standardized regulatory frameworks for the energy sector. In some countries, the success of the market for energy-efficient products, such as LED products, also depends on the capability of LED product manufacturers to form a rapport with local partners.

10.4.1 CHINA

10.4.1.1 Increasing government expenditure on public infrastructure

China is already the largest producer and consumer of lighting fixtures and lamps in the world. Despite the recent slowdown in the real estate, the market for LED lighting is expected to grow at a high rate, mainly because of the increasing government expenditure on public infrastructure and continuous growth in commercial and industrial building constructions.

10.4.2 JAPAN

Japan has been experiencing an unexpected period of political and economic turmoil since the past few years and the government has made huge investments toward economically conducive activities to spur the recovery. Large corporate companies such as Philips Lighting (Netherlands) are continuously investing in LED lighting in Japan as this is a part of company's strategy to strengthen its position in the Asian market. Also, other major lighting companies such as Sharp Corporation (Japan), Koizumi Lighting Technology Corp (Japan) are contributing significantly for the growth of the market in the region.

10.4.2.1 Focus on energy management solutions

The LED lighting market in Japan is majorly focusing on energy management solutions that reduce carbon emissions, increase energy efficiency, and utilize renewable energy sources.

10.4.3 REST OF APAC

Most of the countries covered in Rest of APAC are developing economies with a fast-growing population and economy. Since countries such as Vietnam and Bangladesh are also experiencing fast economic growth and urbanization, there is a significant demand for LED lighting systems in these countries.

10.4.3.1 Australia and Indonesia are emerging markets with significant potential

In Rest of APAC, Australia and Indonesia are emerging as potential countries for the growth of the LED lighting market. The increasing investment opportunities and government policies in certain sectors have enabled most of the players in the lighting industries to expand their presence in these markets.

10.4.3.2 India: Strong economic outlook expected to propel the growth

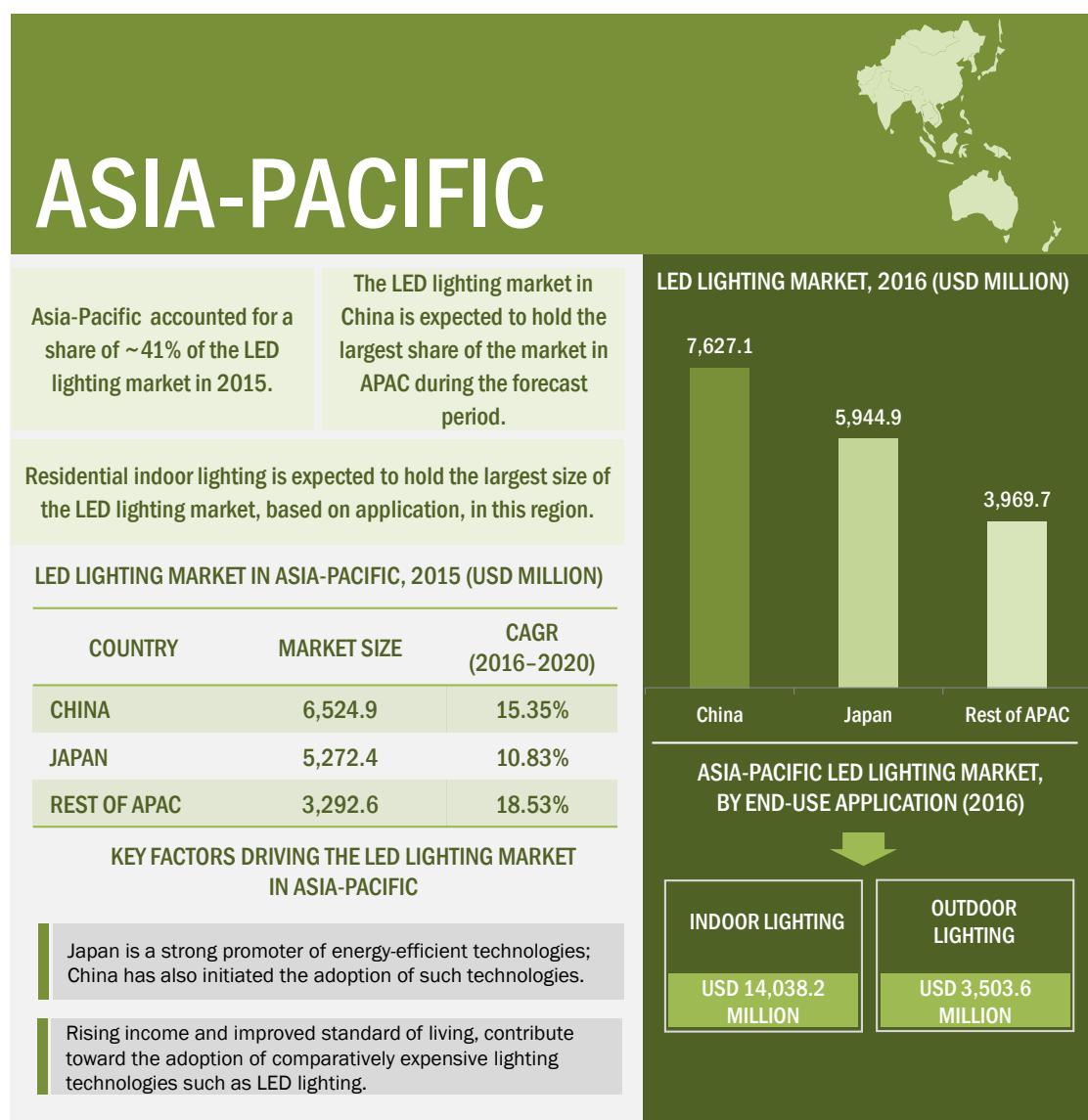
Currently, India is one of the best performing economies in the world in terms of GDP growth. With the large-scale electrification of the country, the demand for lighting fixtures and lamps as well as lighting devices, such as switches, dimmers, and LED drivers, continues to increase. Rapid urbanization in India has further led to a massive surge in outdoor lighting and commercial lighting.

The construction industry is the second-largest economic activity in India after agriculture. The real estate industry in India is expected to witness an annual average growth rate of approximately 26% in 2015. The smart home industry in India is expected to grow as energy preservation is the need of the hour, especially for the well-being of the occupants and also to reduce the negative impact on the environment. The various initiatives taken by the Indian government recently, such as "Housing for All by 2020" and Smart cities, projects would further boost the demand for LED lighting solutions.

10.4.3.3 South Korea: Energy efficiency labels & standards program expected to boost growth of LED lighting systems

South Korea is the most developed and highly industrialized country in Asia-Pacific. The country has developed stringent standards for energy-efficient lighting to combat the effects of rapid globalization and global warming. These standards not only focus on phasing out non-efficient light sources but also on developing lighting controls which can regulate and control the energy usage. According to the International Energy Efficiency Scorecard, South Korea, currently, ranks 8th worldwide in the implementation of the energy efficiency recommendations put forth by the International Energy Association. Samsung Group (South Korea) is an important player in the region.

FIGURE 45 SNAPSHOT OF THE LED LIGHTING MARKET IN APAC



Source: Experts' Interviews, Secondary Research, and MarketsandMarkets Analysis

TABLE 62 LED LIGHTING MARKET IN ASIA-PACIFIC, BY END-USE APPLICATION, 2013–2022 (USD MILLION)

End-Use Application	2013	2014	2015	2016	2018	2020	2022	CAGR (2016–2022)
Indoor Lighting	8,297.8	10,093.9	12,078.7	14,038.2	18,919.7	25,085.7	32,163.9	14.82%
Outdoor Lighting	2,064.5	2,512.9	3,011.2	3,503.6	4,717.6	6,207.5	7,830.5	14.34%
Total	10,362.4	12,606.8	15,089.9	17,541.7	23,637.3	31,293.2	39,994.4	14.72%

Source: Experts' Interviews, Secondary Research, and MarketsandMarkets Analysis

The LED lighting market in Asia-Pacific based on end use application was valued at USD 15,089.9 million in 2015 and is expected to reach USD 39,994.4 million by 2022, at a CAGR of 14.72% during the forecast period. The market for indoor lighting application was valued at USD 12,078.7 million in 2015 and is expected to reach USD 32,163.9 million by 2022, at a CAGR of 14.82% during the forecast period. The market for indoor lighting application is expected to be worth USD 32,163.9 million by 2022, growing at the highest CAGR of 14.82% during the forecast period.

TABLE 63 LED LIGHTING MARKET IN ASIA-PACIFIC FOR INDOOR LIGHTING, BY TYPE, 2013–2022 (USD MILLION)

Type	2013	2014	2015	2016	2018	2020	2022	CAGR (2016–2022)
Residential	4,482.6	5,400.5	6,398.6	7,360.8	9,707.0	12,566.1	15,681.2	13.43%
Commercial	3,437.9	4,207.2	5,064.5	5,921.0	8,073.2	10,824.6	14,023.7	15.45%
Industrial	286.9	360.7	446.9	538.7	787.2	1,148.9	1,657.5	20.60%
Others	90.5	125.5	168.7	217.7	352.3	546.1	801.5	24.26%
Total	8,297.8	10,093.9	12,078.7	14,038.2	18,919.7	25,085.7	32,163.9	14.82%

Source: Experts' Interviews, Secondary Research, and MarketsandMarkets Analysis

The LED lighting market in Asia-Pacific for indoor lighting application was valued at USD 12,078.7 million in 2015 and is expected to reach USD 32,163.9 million by 2022, at a CAGR of 14.82% during the forecast period. The market for the residential application was valued at USD 6,398.6 million in 2015 and is expected to reach USD 15,681.2 million by 2022, at a CAGR of 13.43% during the forecast period. The market for others indoor applications is expected to be worth USD 801.5 million by 2022, growing at the highest CAGR of 24.26% during the forecast period.

TABLE 64 LED LIGHTING MARKET IN ASIA-PACIFIC FOR OUTDOOR LIGHTING, BY TYPE, 2013–2022 (USD MILLION)

Type	2013	2014	2015	2016	2018	2020	2022	CAGR (2016–2022)
Highway & Roadway	872.8	1,078.8	1,311.8	1,548.6	2,146.7	2,912.0	3,796.5	16.12%
Architectural	1,093.6	1,312.4	1,550.8	1,779.1	2,326.0	2,963.1	3,602.6	12.48%
Public Places	68.8	86.4	106.6	127.5	180.5	248.1	324.3	16.85%
Others	29.4	35.4	42.0	48.5	64.5	84.3	107.0	14.11%
Total	2,064.5	2,512.9	3,011.2	3,503.6	4,717.6	6,207.5	7,830.5	14.34%

Source: Experts' Interviews, Secondary Research, and MarketsandMarkets Analysis

The LED lighting market in Asia-Pacific for outdoor lighting was valued at USD 3,011.2 million in 2015 and is expected to reach USD 7,830.5 million by 2022, at a CAGR of 14.34% during the forecast period. The market for the architectural application was valued at USD 1,550.8 million in 2015 and is expected to reach USD 3,602.6 million by 2022, at a CAGR of 12.48% during the forecast period. The market for the public places segment is expected to be valued at USD 324.3 million by 2022, growing at the highest CAGR of 16.85% during the forecast period.

TABLE 65 LED LIGHTING MARKET IN ASIA-PACIFIC, BY INSTALLATION TYPE, 2013–2022 (USD MILLION)

Installation Type	2013	2014	2015	2016	2018	2020	2022	CAGR (2016–2022)
New Installation	8,717.7	10,436.7	12,323.8	14,087.5	18,318.8	23,179.6	27,942.8	12.09%
Retrofit Installation	1,644.6	2,170.1	2,766.1	3,454.3	5,318.5	8,113.5	12,051.6	23.15%
Total	10,362.4	12,606.8	15,089.9	17,541.7	23,637.3	31,293.2	39,994.4	14.72%

Source: Experts' Interviews, Secondary Research, and MarketsandMarkets Analysis

The LED lighting market in Asia-Pacific based on installation type was valued at USD 15,089.9 million in 2015 and is expected to reach USD 39,994.4 million by 2022, at a CAGR of 14.72% during the forecast period. The market for the new installation segment was valued at USD 12,323.8 million in 2015 and is expected to reach USD 27,942.8 million by 2022, at a CAGR of 12.09% during the forecast period. The market for the retrofit installation segment is expected to be valued at USD 12,051.6 million by 2022, growing at the highest CAGR of 23.15% during the forecast period.

TABLE 66 LED LIGHTING MARKET IN ASIA-PACIFIC, BY COUNTRY, 2013–2022 (USD MILLION)

Country	2013	2014	2015	2016	2018	2020	2022	CAGR (2016–2022)
China	4,430.9	5,420.9	6,524.9	7,627.1	10,391.0	13,906.7	17,969.5	15.35%
Japan	3,840.3	4,538.5	5,272.4	5,944.9	7,509.6	9,284.7	11,018.5	10.83%
Rest of APAC	2,091.1	2,647.4	3,292.6	3,969.7	5,736.8	8,101.8	11,006.5	18.53%
Total	10,362.4	12,606.8	15,089.9	17,541.7	23,637.3	31,293.2	39,994.4	14.72%

Source: Experts' Interviews, Secondary Research, and MarketsandMarkets Analysis

The LED lighting market in Asia-Pacific was valued at USD 15,089.9 million in 2015 and is expected to reach USD 39,994.4 million by 2022, at a CAGR of 14.72% during the forecast period. The market in China was valued at USD 6,524.9 million in 2015 and is expected to reach USD 17,969.5 million by 2022, at a CAGR of 15.35% during the forecast period. The market in Rest of APAC is expected to be valued at USD 11,006.5 million by 2022, growing at the highest CAGR of 18.53% during the forecast period.

10.5 REST OF THE WORLD (ROW)

The RoW region includes Latin America, the Middle East and Africa. The Middle East includes GCC countries such as Saudi Arabia, the UAE, and Qatar, among others. Africa includes South Africa, Nigeria, Kenya, Angola, and other countries. Latin America includes Mexico, Brazil, Argentina, and Chile, among others. The ongoing construction activities in the Middle Eastern countries are expected to significantly drive the LED lighting market in the region.

10.5.1.1 Focus on real estate & urbanization

In the next five years, around 1.2 million homes are expected to be constructed in Saudi Arabia, which would significantly drive the LED lighting market in the country. Moreover, many of the African nations are experiencing a healthy economic growth backed by the revenues earned from commodity and natural resources exports. This has led to large-scale electrification and facilitated the access to lighting for a large population. The strong economic growth is also expected to result into rapid urbanization which is expected to significantly boost the market for LED lighting in the region.

TABLE 67 LED LIGHTING MARKET IN ROW, BY END-USE APPLICATION, 2013–2022 (USD MILLION)

End-Use Application	2013	2014	2015	2016	2018	2020	2022	CAGR (2016–2022)
Indoor Lighting	1,925.4	2,449.5	2,875.3	3,605.1	5,047.2	6,656.8	9,141.9	16.78%
Outdoor Lighting	479.1	609.8	716.8	899.8	1,258.5	1,647.2	2,225.7	16.29%
Total	2,404.5	3,059.3	3,592.1	4,504.9	6,305.7	8,304.1	11,367.5	16.68%

Source: Experts' Interviews, Secondary Research, and MarketsandMarkets Analysis

The LED lighting market in RoW based on end-use application was valued at USD 3,592.1 million in 2015 and is expected to reach USD 11,367.5 million by 2022, at a CAGR of 16.68% during the forecast period. The market for indoor lighting application was valued at USD 2,875.3 million in 2015 and is expected to reach USD 9,141.9 million by 2022, at a CAGR of 16.78% during the forecast period. The market for indoor lighting application is expected to be worth USD 9,141.9 million by 2022, growing at a higher CAGR of 16.78% during the forecast period.

TABLE 68 LED LIGHTING MARKET IN ASIA-PACIFIC FOR INDOOR LIGHTING, BY TYPE, 2013–2022 (USD MILLION)

Type	2013	2014	2015	2016	2018	2020	2022	CAGR (2016–2022)
Residential	1,040.1	1,310.5	1,523.2	1,890.3	2,589.5	3,334.6	4,457.0	15.37%
Commercial	797.7	1,021.0	1,205.6	1,520.6	2,153.7	2,872.5	3,985.9	17.42%
Industrial	66.6	87.5	106.4	138.3	210.0	304.9	471.1	22.66%
Others	21.0	30.5	40.2	55.9	94.0	144.9	227.8	26.38%
Total	1,925.4	2,449.5	2,875.3	3,605.1	5,047.2	6,656.8	9,141.9	16.78%

Source: Experts' Interviews, Secondary Research, and MarketsandMarkets Analysis

The LED lighting market in RoW for indoor lighting was valued at USD 2,875.3 million in 2015 and is expected to reach USD 9,141.9 million by 2022, at a CAGR of 16.78% during the forecast period. The market for the residential application was valued at USD 1,523.2 million in 2015 and is expected to reach USD 4,457.0 million by 2022, at a CAGR of 15.37% during the forecast period. The market for other indoor

applications is expected to be valued at USD 227.8 million by 2022, growing at the highest CAGR of 26.38% during the forecast period.

TABLE 69 LED LIGHTING MARKET IN ROW FOR OUTDOOR LIGHTING, BY TYPE, 2013–2022 (USD MILLION)

Type	2013	2014	2015	2016	2018	2020	2022	CAGR (2016–2022)
Highway & Roadway	202.5	261.8	312.3	397.7	572.7	772.7	1,079.1	18.10%
Architectural	253.8	318.5	369.2	456.9	620.5	786.3	1,024.0	14.40%
Public Places	16.0	21.0	25.4	32.7	48.1	65.8	92.2	18.84%
Others	6.8	8.6	10.0	12.5	17.2	22.4	30.4	16.06%
Total	479.1	609.8	716.8	899.8	1,258.5	1,647.2	2,225.7	16.29%

Source: Experts' Interviews, Secondary Research, and MarketsandMarkets Analysis

The LED lighting market in RoW for outdoor lighting was valued at USD 716.8 million in 2015 and is expected to reach USD 2,225.7 million by 2022, at a CAGR of 16.29% during the forecast period. The market for the architectural application was valued at USD 369.2 million in 2015 and is expected to reach USD 1,024.0 million by 2022, at a CAGR of 14.4% during the forecast period. The market for public places application is expected to be valued at USD 92.2 million by 2022, growing at the highest CAGR of 18.84% during the forecast period.

TABLE 70 LED LIGHTING MARKET IN ROW, BY INSTALLATION TYPE, 2013–2022 (USD MILLION)

Installation Type	2013	2014	2015	2016	2018	2020	2022	CAGR (2016–2022)
New Installation	1,949.9	2,444.4	2,835.3	3,519.1	4,612.4	5,717.9	7,310.3	12.96%
Retrofit Installation	454.6	614.9	756.8	985.8	1,693.3	2,586.2	4,057.3	26.59%
Total	2,404.5	3,059.3	3,592.1	4,504.9	6,305.7	8,304.1	11,367.5	16.68%

Source: Experts' Interviews, Secondary Research, and MarketsandMarkets Analysis

The LED lighting market in RoW based on installation type was valued at USD 3,592.1 million in 2015 and is expected to reach USD 11,367.5 million by 2022, at a CAGR of 16.68% during the forecast period. The market for the new installation segment was valued at USD 2,835.3 million in 2015 and is expected to reach USD 7,310.3 million by 2022, at a CAGR of 12.96% during the forecast period. The market for the retrofit installation segment is expected to be worth USD 4,057.3 million by 2022, growing at the highest CAGR of 26.59% during the forecast period.

TABLE 71 LED LIGHTING MARKET IN ROW, BY REGION, 2013–2022 (USD MILLION)

Region	2013	2014	2015	2016	2018	2020	2022	CAGR (2016–2022)
Middle East and Africa	1,531.4	1,988.6	2,382.0	3,046.4	4,429.5	6,051.2	8,581.7	18.84%
Latin America	873.1	1,070.8	1,210.1	1,458.5	1,876.1	2,252.9	2,785.8	11.39%
Total	2,404.5	3,059.3	3,592.1	4,504.9	6,305.7	8,304.1	11,367.5	16.68%

Source: Experts' Interviews, Secondary Research, and MarketsandMarkets Analysis

The LED lighting market in RoW was valued at USD 3,592.1 million in 2015 and is expected to reach USD 11,367.5 million by 2022, at a CAGR of 16.68% during the forecast period. The market in the Middle East and Africa was valued at USD 2,382.0 million in 2015 and is expected to reach USD 8,581.7 million by 2022, at a higher CAGR of 18.84% during the forecast period.

11 COMPETITIVE LANDSCAPE

11.1 INTRODUCTION

This section of the report provides an overview of the prevailing competitive scenario in the global LED lighting market. As part of this, the market ranking has been carried out on the company's market reach, market share, revenue (in USD Million), and R&D-related investments in the LED lighting ecosystem. Furthermore, the analysis of the strategies adopted by the key players in the last three to four years has also been carried out. This involves the analysis of developments such as new product launches, expansions, and partnerships/agreements/collaborations.

FIGURE 46 COMPANIES ADOPTED NEW PRODUCT LAUNCHES AS THE KEY GROWTH STRATEGY BETWEEN 2014 AND 2016

COMPANY NAME	ORGANIC GROWTH STRATEGIES		INORGANIC GROWTH STRATEGIES
	New Product Launches	Product Developments	
PHILIPS LIGHTING HOLDING B.V. (NETHERLANDS)	Philips Lighting launched a new technology enabling city authorities to retrofit existing LED street lights with its CityTouch connector node, a plug-and-play system that uses the cellular network to connect LED street lights from any manufacturer for remote management.		Philips entered into an agreement to acquire 51% stake of General Lighting Company, Kingdom of Saudi Arabia. The joint venture would help Philips to strengthen its position in the Kingdom of Saudi Arabia.
GENERAL ELECTRIC COMPANY (U.S.)	GE launched Bright Stik LED, a redesigned, entry point 60-watt replacement LED, specifically made to replace CFL lamps.		GE Lighting entered into a partnership with the local government of the city of San Diego, U.S., to implement GE's intelligent cities platform on a pilot basis. This partnership is expected to improve the traffic in the city and reduce the consumption of energy.
OSRAM LICHT AG (GERMANY)	OSRAM's opto semiconductors segment launched a new LED for stage lighting. This new product generates lumen output which is twice that of Osram's earlier products.	OSRAM expanded its LED floodlight range with the launch of the Floodlight 20 Maxi LED. The flexible floodlight series is available in four sizes and with luminaire luminous flux levels from 3,000 to 100,000 lumens.	
CREE, INC. (U.S.)	Cree launched a new 13,000-lumen Cree canopy luminaire which offers superior illumination and industry-leading efficiency as well as easy installation and lower total cost of ownership for better light experiences.		Cree, Inc. and Avnet, Inc. announced a strategic agreement that expands coverage in the Americas for the distribution of Cree's comprehensive portfolio of innovative LED components including chip-on-board and LED modules.
COOPER INDUSTRIES, INC. (IRELAND)	Eaton announced the launch of the Dim-to-Warm (D2W) technology in its portfolio of Halo LED recessed downlighting product lines for use of residential and commercial spaces. The technology incorporated in it mimics the function of an incandescent halogen lamp source when it is dimmed, from a white LED color temperature to a warm, soft glow.	Eaton announced the expansion of the Lumark Night Falcon LED Floodlight Luminaire family. These LEDs are available in multiple wattages. The Night Falcon series is designed to replace high-intensity discharge (HID) lamps with power of 70W-1,000W range, mainly used for floodlighting applications.	Eaton announced a collaboration with NuLEDS, Inc., a leader in Power-over-Ethernet (PoE) lighting systems, for the making of smart buildings.

Note -  indicates events that are expected to have a significant impact on the market.

Source: Press Releases, Experts' Interviews, and MarketsandMarkets Analysis

11.2 RANKING OF MARKET PLAYERS, 2015

The competitive landscape describes the market ranking of the top players in the global LED lighting market.

The Top 5 players in the market are Phillips Lighting Holding B.V. (Netherlands), General Electric Company (U.S.), OSRAM Licht AG (Germany), Cree, Inc. (U.S.), and Cooper Industries, Inc. (Ireland). The other players in this market include Virtual Extension (Israel), Dialight plc (U.K.), Zumtobel Group AG (Austria), Samsung (South Korea), and Sharp Corporation (Japan).

The table below shows the ranking of the top players according to their contribution in terms of products and share in the LED lighting market.

TABLE 72 RANKING OF THE TOP 5 PLAYERS IN THE LED LIGHTING MARKET, 2015

Company	Ranking
Philips Lighting Holding B.V. (Netherlands)	1
General Electric Company (U.S.)	2
OSRAM Licht AG (Germany)	3
Cree, Inc. (U.S.)	4
Cooper Industries, Inc. (Ireland)	5

Note: The ranking has been estimated based on the respective company's market reach, market share, revenue (in USD Million), and R&D-related investments in the LED lighting ecosystem. The secondary research along with in-depth primary interviews conducted with key industry leaders has contributed to this analysis.

Source: Annual Reports, Press Releases, Investor Presentations, Primary Interviews, and MarketsandMarkets Analysis

Philips Lighting Holding B.V. (Netherlands) has been ranked first in the LED lighting market. Capturing market opportunities and creating value for its customers is the core competency of the company. The developed market experience and brand name have enabled the company to capitalize on the fundamental market dynamics taking place in the lighting industry and deliver innovative solutions that create value and ensure its growth. The company aims to further invest in LED leadership while capitalizing on a broad product portfolio, widespread distribution, and strong brand in conventional and LED lighting by anticipating and managing the phase-out of conventional products. This key strategy helped Philips win numerous contracts to supply connected LED systems and other lighting control equipment. For instance, in 2014, Philips entered into a contract with the government of Spain to provide the city of Madrid with 225,000 energy-efficient street lights. The renewal of the city's entire street lighting system makes it the world's largest street lighting upgrade to date.

General Electric Company (U.S.) has been ranked second in this market. GE is working with several other companies and government agencies across the U.S. to implement LED technology in parking lots and garages and streets to help improve lighting during the night to increase safety and security. The company has undertaken projects to illuminate parking spaces with LED street lights across several cities in the U.S. It is also testing its intelligent cities platform which can improve city traffic through efficient street lighting and signaling and achieve reduced energy consumption. GE is also collaborating with retail outlets to enhance the shopping experience through the efficient use of LED lighting.

OSRAM (Germany) has been ranked third in the LED lighting market. OSRAM announced its intention to increase its focus on the automotive lighting, smart lighting, and LED components market. By adopting the strategy of reorganizing business segments and eliminating underperforming businesses, the company seeks to target business-to-business (B2B) and semiconductor markets where there is scope to earn higher profit margins. The company is expanding its LED chip-based investments and facilities in Germany and Malaysia. R&D and innovation are its prime strengths and the company is expected to rely on that for

future expansions in the market. It has launched several new products for automotive lighting, smart lighting, and other lighting applications.

Cree, Inc. (U.S.) has been ranked fourth in the LED lighting market. Cree's 30 years of experience in the lighting segment has made it an undisputed leader in the LED lighting market. Over the last three years, it has launched innovative products for the lighting segment focusing on energy and cost-efficiency. It also follows the strategy of agreements with other organizations to gain geographic foothold as well as market share in a particular region. For example, Cree signed an agreement with Avnet, Inc. to expand its coverage in the Americas for the distribution of their innovative LED components.

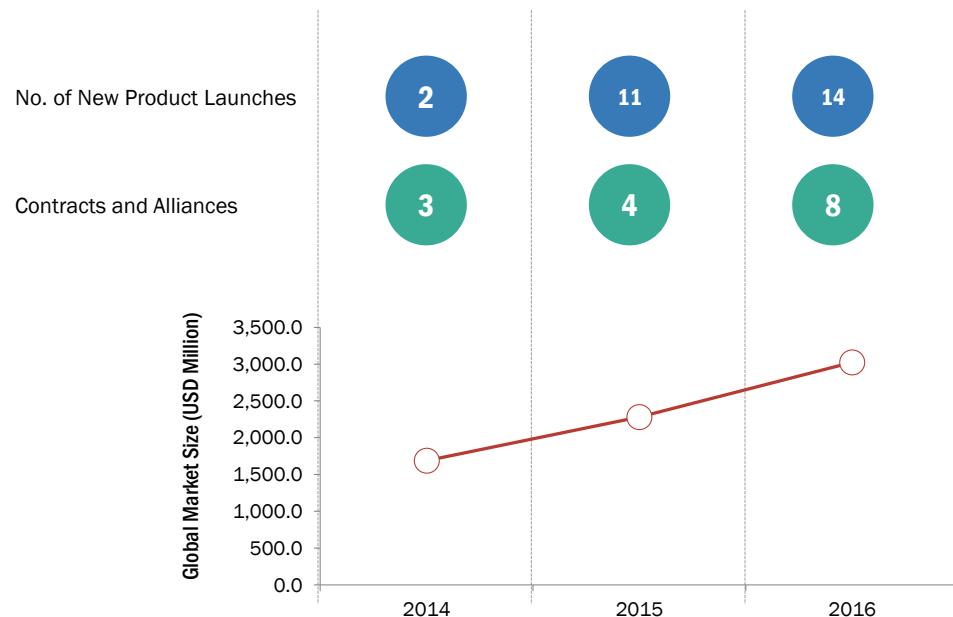
The next ranked company in the LED lighting market is Cooper Industries, Inc. (Ireland). The company focuses on geographic expansion to increase its footprint. It has acquired many companies to capitalize on their technologies and strategies. For instance, it acquired the distribution business of Gycom Electricals (Sweden) in Sweden, Finland, and Denmark to expand its business in these countries. The company may launch new products and increase its portfolio of electrical products to gain a competitive advantage in the market.

11.3 COMPETITIVE SITUATIONS AND TRENDS

The global LED lighting market is highly competitive with the presence of a large number of players. This segment studies the growth strategies adopted by the players between 2014 and 2016.

Players in this market adopted various strategies to expand their global presence and increase their market share. New product launches, contracts, and partnerships are some of the major strategies adopted by the players to achieve growth in the LED lighting market.

FIGURE 47 MARKET EVALUATION FRAMEWORK: CONTRACTS, AGREEMENTS, PARTNERSHIPS, AND ALLIANCES FUELED GROWTH AND INNOVATION BETWEEN 2014 AND 2016



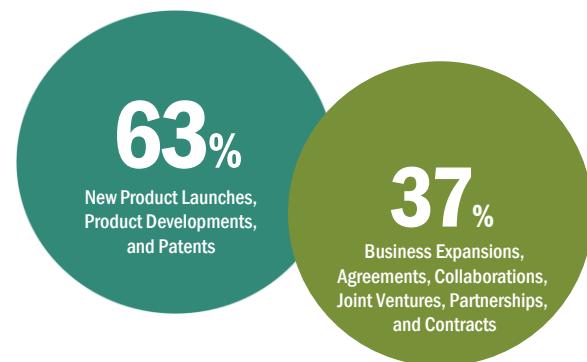
Source: Annual Reports, SEC Filings, Press Releases, Investor Presentations, Experts' Interviews, and MarketsandMarkets Analysis

FIGURE 48 BATTLE FOR MARKET SHARE: NEW PRODUCT LAUNCHES AND PRODUCT DEVELOPMENTS WERE THE KEY STRATEGIES ADOPTED BETWEEN 2015 AND 2016

The major companies employed a number of strategies such as new product launches and product developments to gain a competitive edge over others and achieve growth in the market. New product launches, product developments, and patents collectively accounted for almost ~63% share of the total strategic developments.

The analysis of the key growth strategies adopted by the top players in the recent years has been depicted in the adjacent figure.

Besides new product launches, companies also adopted the strategies of agreements, collaborations, joint ventures, partnerships, and contracts. These strategies collectively accounted for a share of ~37% of the total number of growth strategies adopted by the players in the LED lighting market between 2014 and 2016.



11.3.1 NEW PRODUCT LAUNCHES, EXPANSIONS, AND PATENTS

The strategy of new product launches, product developments, and patents collectively accounted for the largest share of 63% of the total strategic developments in the global LED lighting market. Companies adopted these strategies to develop new and advanced products to strengthen their product portfolio and cater to their customers' requirements. The leading companies that adopted these strategies are Phillips Lighting Holding B.V. (Netherlands), General Electric Company (U.S.), OSRAM Licht AG (Germany), Cree, Inc. (U.S.), and Cooper Industries, Inc. (Ireland), among others.

TABLE 73 NEW PRODUCT LAUNCHES, EXPANSIONS, AND PATENTS IN THE LED LIGHTING MARKET, 2015–2016

Date	Company	Development
August 2016	Cooper Industries, Inc. (Ireland)	Eaton announced the expansion of the Lumark Night Falcon LED Floodlight Luminaire family. These LEDs are available in multiple wattages. The Night Falcon series is designed to replace high-intensity discharge (HID) lamps with power of 70W–1,000W range, mainly used for floodlighting applications.
June 2016	Cree, Inc. (U.S.)	Cree, Inc. expanded its industry-leading portfolio of LEDs optimized for horticulture lighting with the introduction of the new Cree XLamp XQ-E Photo Red LED. The XQ-E Photo Red LED is capable of providing very high levels of growth-promoting light wavelengths from a footprint that is less than one-third the size of its closest competitor with similar output.
April 2016	OSRAM Licht AG (Germany)	OSRAM expanded its LED floodlight range with the launch of the Floodlight 20 Maxi LED. The flexible floodlight series is available in four sizes and with luminaire luminous flux levels from 3,000 to 100,000 lumens.
October 2015	General Electric Company (U.S.)	GE announced the release of its first connected LEDs designed for sleep and daily illumination—called C by GE. These can be controlled without using a smart hub.

April 2015	Philips Lighting Holding B.V. (Netherlands)	Philips Lighting launched a new technology enabling city authorities to retrofit existing LED street lights with its CityTouch connector node, a plug-and-play system that uses the cellular network to connect LED street lights from any manufacturer for remote management.
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11.3.2 ALLIANCES, BUSINESS EXPANSIONS, AND CONTRACTS

Partnerships, agreements, joint ventures, and collaborations collectively accounted for a share of 37% of the overall growth strategies adopted by the players in the LED lighting market.

Zumtobel Group AG (Austria), Cree, Inc. (U.S.), Cooper Industries, Inc. (Ireland), Dialight plc (U.K.), and Philips Lighting Holding B.V. (Netherlands), among others, are some of the leading companies that adopted these strategies to achieve growth in the LED lighting market.

TABLE 74 ALLIANCES, BUSINESS EXPANSIONS, AND CONTRACTS IN THE LED LIGHTING MARKET, 2016

Date	Company	Development
September 2016	Zumtobel Group AG (Austria)	Zumtobel received a contract from FARO Foundation located in Windisch, Switzerland, for providing NOW service (LaaS) for its new office. This contract would provide benefits to FARO such as improved lighting quality and energy efficiency.
July 2016	Cree, Inc. (U.S.)	Cree, Inc. and Avnet, Inc. announced a strategic agreement that expands coverage in the Americas for the distribution of Cree's comprehensive portfolio of innovative LED components including chip-on-board and LED modules.
July 2016	Cooper Industries, Inc. (Ireland)	Eaton announced a collaboration with NuLEDs, Inc., a leader in Power-over-Ethernet (PoE) lighting systems, for the making of smart buildings.
April 2016	Dialight plc (U.K.)	Dialight announced that it joined the Rockwell Automation PartnerNetwork for Encompass, a product referencing program. The partnership with Rockwell Automation systems would help different industrial facilities in leveraging the energy- and maintenance-saving benefits of Dialight high-performance LED lighting.
March 2016	Philips Lighting Holding B.V. (Netherlands)	Philips Lighting and Cisco collaborated with Smartworld, an Etisalat and Dubai South joint venture company, to create a smart, secure, and connected indoor space at its new headquarter in Dubai South. The implementation brings together an advanced LED connected lighting system from Philips Lighting and Cisco's (U.S.) secure IT network.

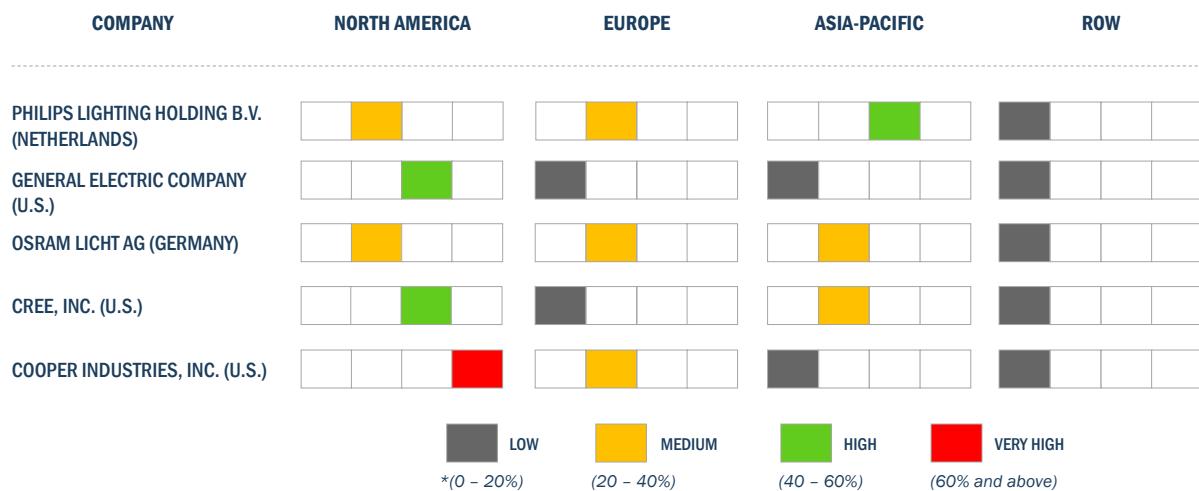
12 COMPANY PROFILES

12.1 INTRODUCTION

This chapter profiles the major players in the LED lighting market. It provides information about the business overview, products and services offered, recent developments, and the MnM view of the companies covered in this section, namely, Philips Lighting Holding B.V. (Netherlands), General Electric Company (U.S.), OSRAM Licht AG (Germany), Cree, Inc. (U.S.), Cooper Industries, Inc. (Ireland), Virtual Extension (Israel), Dialight plc (U.K.), Zumtobel Group AG (Austria), Samsung (South Korea), and Sharp Corporation (Japan).

The products and services offered by the company with regard to the LED lighting market are listed in the “products and services” section. The “recent developments” section contains the most recent and important developments made by the company in the LED lighting market. The chapter also presents the SWOT analysis of eight major companies, five of which are the key players, under the “MnM view” section.

FIGURE 49 GEOGRAPHIC REVENUE MIX OF THE MAJOR PLAYERS IN THE LED LIGHTING MARKET, 2015



Note: The geographic share is derived from the overall revenue of individual companies in 2015.

Source: Company Website, Annual Reports, SEC Filings, and MarketsandMarkets Analysis

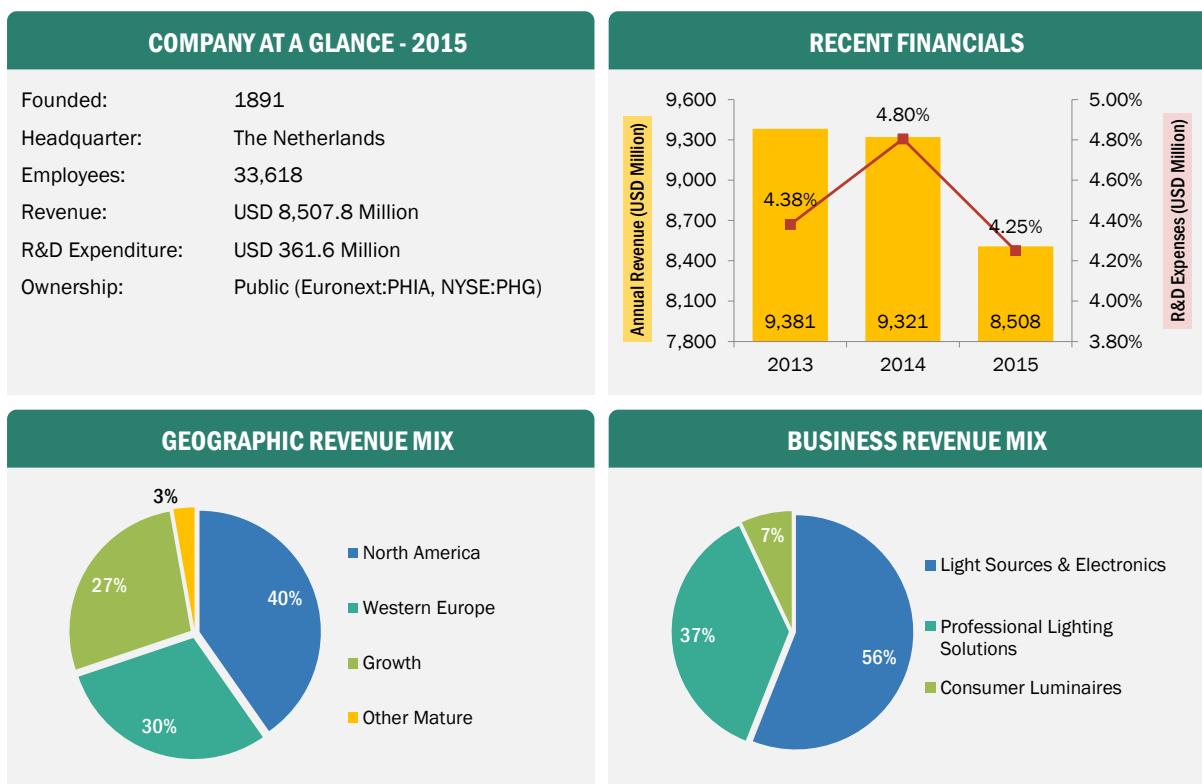
12.2 PHILIPS LIGHTING HOLDING B.V.

12.2.1 BUSINESS OVERVIEW

Philips Lighting (NYSE:PHG, AEX:PHIA) is the global leader in lighting products, systems, and services. The company was established in 1891, and is headquartered in Eindhoven, Netherlands. It caters to professional and consumer markets through its energy-efficient LED lighting. It is an industry leader in connected lighting systems and services and is leveraging the Internet of Things to help transform homes, buildings, and urban spaces. As of 2015, it had sales of USD 8.50 billion and employed 33,618 people worldwide. The lighting business segment of the company operates in over 60 countries and has manufacturing facilities in Europe, South America, and Asia-Pacific. The company has 95 production facilities and 60 research and development (R&D) centers across the operating regions. Philips Lighting is a global market leader with recognized expertise in the development, manufacturing, and application of innovative green lighting products, energy-efficient lighting products, systems, and services.

The company's competitors include General Electric Company (U.K.), Honeywell International Inc. (U.S.), Siemens Limited (Germany), Matsushita Electric Industrial Company Limited (U.S.), and LG Electronics (South Korea).

FIGURE 50 PHILIPS LIGHTING HOLDING B.V.: COMPANY SNAPSHOT



Note: Exchange rates for EUR to USD for the years 2013, 2014, and 2015 are 1.313, 1.357, and 1.148, respectively.

Source: Company Website, Annual Reports, and SEC Filings

12.2.2 PRODUCTS OFFERED

The company offers the following products:

Category	Product
LED Lighting	<ul style="list-style-type: none"> • Indoor luminaires • Outdoor luminaires • LED lamps • MASTER LEDtube

Source: Company Website, Annual Reports, and SEC Filings

12.2.3 RECENT DEVELOPMENTS

Date	Approach	Description
May 2016	Contract	Philips Lighting signed an agreement with vente-privee (France), an e-commerce company, to illuminate its most recent Le Vérone building. The architectural creation was designed by a renowned Italian artist, Pucci de Rossi, who created an impression of a galaxy of lights by incorporating 1,950 LED light points using iColor Flex LMX gen2 from Philips Color Kinetics.
March 2016	Contract	Philips Lighting and Cisco collaborated with Smartworld, an Etisalat and Dubai South joint venture company, to create a smart, secure, and connected indoor space at its new headquarter in Dubai South. The implementation brings together an advanced LED connected lighting system from Philips Lighting and Cisco's (U.S.) secure IT network.
May 2015	Contract	Philips announced that it would be working with the New York State Thruway Authority and Tappan Zee Constructors, LLC (U.S.) to install a state-of-the-art connected LED lighting system on the New NY Bridge to replace the Tappan Zee across the Hudson River.
April 2015	New Product Launch	Philips Lighting launched a new technology enabling city authorities to retrofit existing LED street lights with its CityTouch connector node, a plug-and-play system that uses the cellular network to connect LED street lights from any manufacturer for remote management.
March 2015	Contract	Philips has been selected by the city of Szczecin in Poland to renew its street lighting system with LED technology. Under this contract, Philips would replace 5,000 existing street lights with new LED luminaires by September 2015, reducing the city's total energy expenditure by USD 390,000 per year.
December 2014	Contract	Philips signed a contract with the government of the city of Madrid to provide it with 225,000 new energy-efficient lights. This renewal of the entire street lighting system with Philips' connected LEDs and other energy-efficient lighting is the world's largest street lighting upgrade to date.
March 2014	Agreement/Joint Venture	Philips entered into an agreement to acquire 51% stake of General Lighting Company, Kingdom of Saudi Arabia. The joint venture would help Philips to strengthen its position in the Kingdom of Saudi Arabia.

Source: Company Website, Annual Reports, and SEC Filings

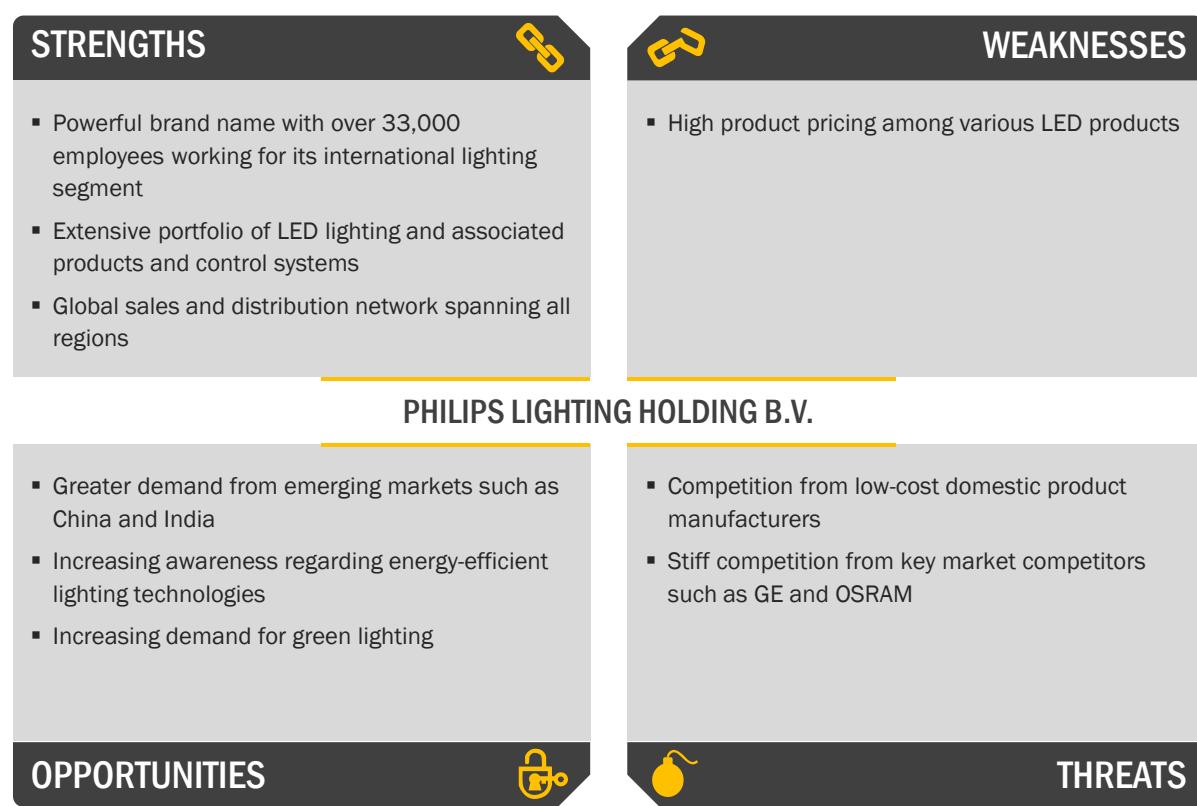
12.2.4 MNM VIEW

Philips is one of the industry leaders in the LED lighting market. Capturing market opportunities and creating value for its customers is the core competency of the company. The developed market experience and brand name have enabled the company to capitalize on the fundamental market dynamics taking place in the lighting industry and deliver innovative solutions that create value and ensure its growth. The company aims to further invest in LED leadership while capitalizing on a broad product portfolio, widespread distribution, and strong brand in conventional and LED lighting by anticipating and managing the phase-out of conventional products. This key strategy helped Philips win numerous contracts to supply connected LED systems and other lighting control equipment. For instance, in 2014, Philips entered into a contract with the government of Spain to provide the city of Madrid with 225,000 energy-efficient street lights. The renewal of the city's entire street lighting system makes it the world's largest street lighting upgrade to date. Moreover, at major sports events in Russia (Sochi) and Brazil, the company helped light up the majority of the stadiums. For Chelsea FC, Philips installed an LED pitch lighting solution designed to provide players, fans, and television broadcasters with an outstanding visual experience.

Furthermore, the company also followed the strategy of acquisitions. For instance, in March 2014, Philips acquired 51% of General Lighting Company (GLC) in the Kingdom of Saudi Arabia. This acquisition combines Philips' expertise in LED technology and global supply base with GLC's deep local market knowledge and strong commercial capabilities, making it the leading lighting player in the Middle East.

12.2.4.1 SWOT analysis

FIGURE 51 PHILIPS LIGHTING HOLDING B.V.: SWOT ANALYSIS



12.3 GENERAL ELECTRIC COMPANY

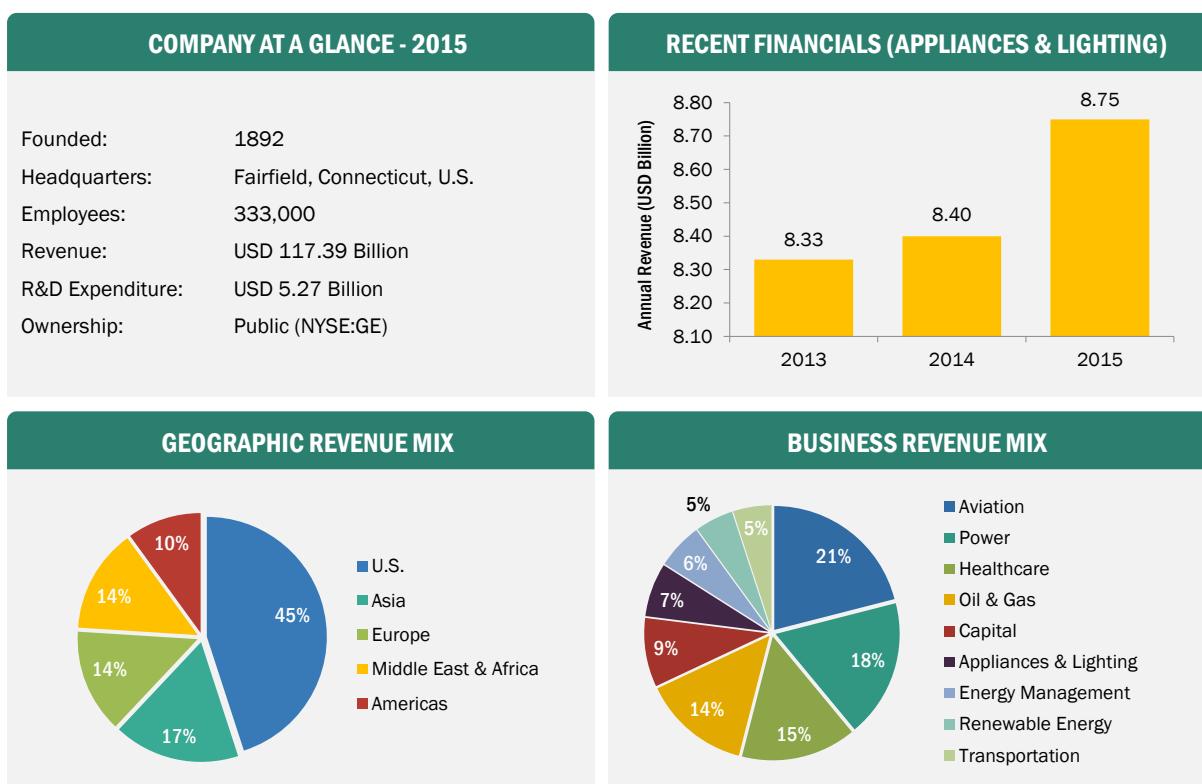
12.3.1 BUSINESS OVERVIEW

General Electric Company (GE) is one of the world's largest multinational conglomerates, operating as an infrastructure and financial services company worldwide. It was formed in 1892 by the merger of Edison General Electric Company (U.S.) and Thomson-Houston Electric Company (U.S.). It has its headquarters in Fairfield, Connecticut (U.S.). The business segments of this company are power and water, oil and gas, energy management, aviation, healthcare, transportation, appliances and lighting, and GE capital. GE reported a global headcount of 333,000 as of December 2015.

GE's appliances and lighting business segment includes the lighting products portfolio which is primarily directed at consumer applications under the Reveal and Energy Smart brands. The company also manufactures energy-efficient lighting solutions for commercial, industrial, and municipal applications under the brand names Evolve, GTx, Immersion, Infusion, Lumination, Albea, TriGain, and Tetra. GE's appliances and lighting segment had an approximate headcount of 24,000 as of 2015.

The main competitors of the company are Nichia Corporation (Japan), OSRAM Licht AG (Germany), and Royal Philips Electronics N.V. (Netherlands).

FIGURE 52 GENERAL ELECTRIC COMPANY: COMPANY SNAPSHOT



Source: Company Website, Annual Reports, and SEC Filings

12.3.2 PRODUCTS OFFERED

The company offers the following products:

Category	Product
LED Lighting	<ul style="list-style-type: none"> • LED components • LED lamps and modules

Source: Company Website, Annual Reports, and SEC Filings

12.3.3 RECENT DEVELOPMENTS

Date	Approach	Description
October 2015	New Product Launch	GE announced the release of its first connected LEDs designed for sleep and daily illumination —called C by GE. These can be controlled without using a smart hub.
June 2015	New Product Launch	GE launched Bright Stik LED, a redesigned, entry point 60-watt replacement LED, specifically made to replace CFL lamps.
March 2015	New Product Launch	GE launched a new technology, TriGain, which is the enhanced version of potassium fluorosilicate (PFS) phosphors. TriGain phosphors offer improved narrow red band performance and can be used in LED-based display backlight applications.
March 2015	New Product Launch	The company launched a light bulb named GE Align which can promote the human body's natural sleep cycle. GE Align LED lighting technology controls the concentration of blue light output and thus aids the natural sleep cycle.
February 2015	Partnership	GE Lighting entered into a partnership with the local government of the city of San Diego, U.S., to implement GE's intelligent cities platform on a pilot basis. This partnership is expected to improve the traffic in the city and reduce the consumption of energy.

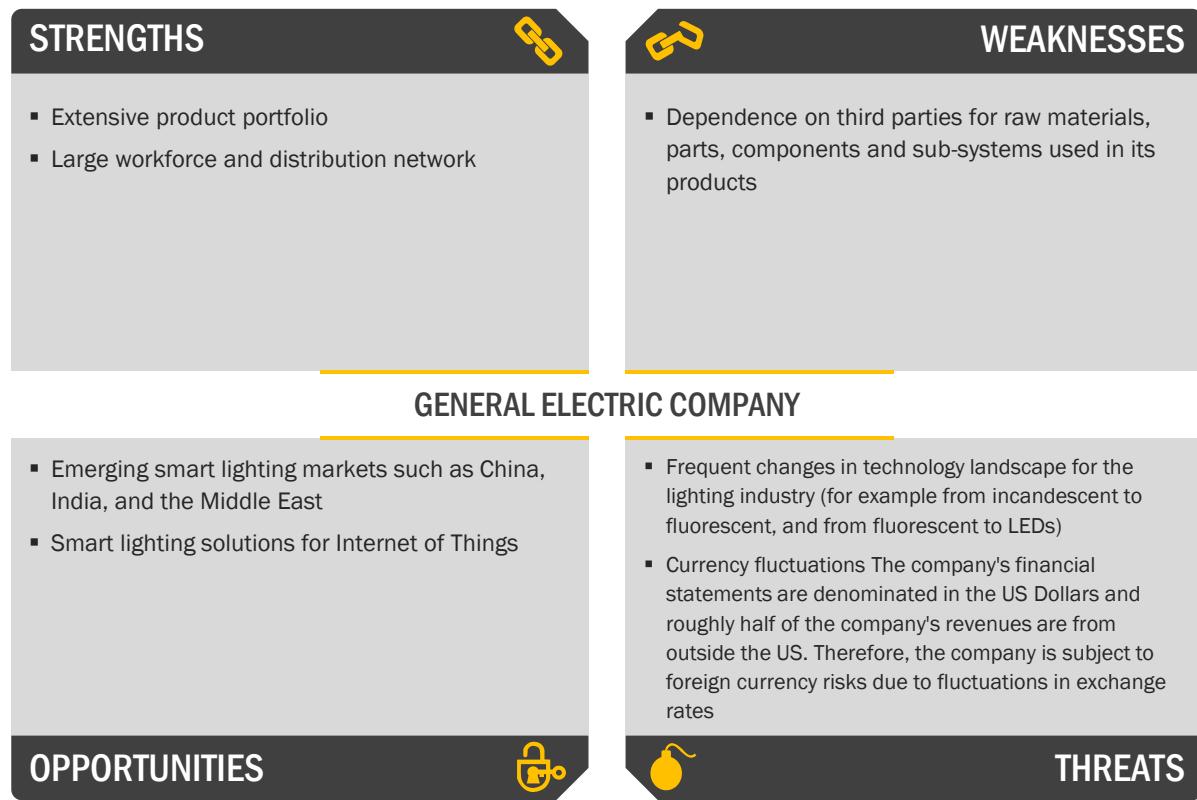
Source: Company Website, Annual Reports, and SEC Filings

12.3.4 MNM VIEW

GE is working with several other companies and government agencies across the U.S. to implement LED technology in parking lots and garages and streets to help improve lighting during the night to increase safety and security. The company has undertaken projects to illuminate parking spaces with LED street lights across several cities in the U.S. It is also testing its intelligent cities platform which can improve city traffic through efficient street lighting and signaling and achieve reduced energy consumption. GE is also collaborating with retail outlets to enhance the shopping experience through the efficient use of LED lighting.

12.3.4.1 SWOT analysis

FIGURE 53 GENERAL ELECTRIC COMPANY: SWOT ANALYSIS



Source: Company Website, Industry Journals, and MarketsandMarkets Analysis

12.4 OSRAM LICHT AG

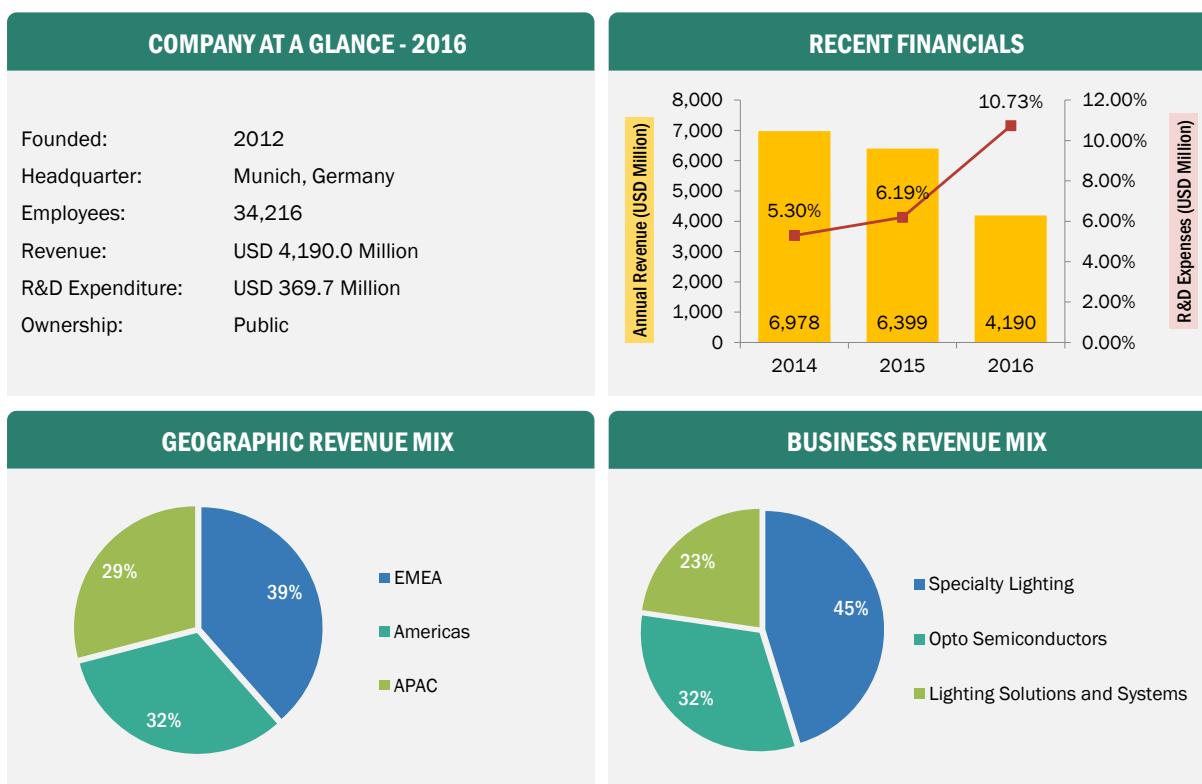
12.4.1 BUSINESS OVERVIEW

OSRAM Licht AG was founded in 2012 and has its headquarters in Munich, Germany. The company operates through its specialty lighting, opto semiconductors, lighting solutions and systems, and lamps segments. OSRAM discontinued its operations of the lamps segment in 2016. OSRAM Licht AG also provides lighting solutions and specialty products featuring energy-saving technologies. OSRAM is one of the major suppliers of automotive lamps and LED lights for vehicles. The company has two subsidiaries, namely, OSRAM Opto Semiconductors GmbH (Germany) that designs and manufactures opto-semiconductor products and OSRAM Sylvania, Inc. (U.S.) that produces and markets a wide variety of lighting products for businesses, homes, and vehicles.

The main subsidiaries of the company are OSRAM A.S. (Slovakia), OSRAM Argentina S.A.C.I. (Argentina), OSRAM China Lighting Ltd. (China), OSRAM Indonesia Pt (Indonesia), OSRAM Lighting Control Systems Limited (China), OSRAM Pte. Ltd. (Singapore), Siteco Lighting GmbH (Germany), OSRAM Philippines Limited Corp. (Philippines), etc. The company's main market is North America and it sells its products under two brand names, namely, Sylvania and OSRAM. Currently, OSRAM has manufacturing plants at 46 sites in 17 countries and supplies its products in about 150 countries spanning Europe, Asia-Pacific, and the Americas.

The main competitors of OSRAM Licht AG are GE Lighting (U.S.), Samsung Electronics Co., Ltd. (Korea), and Royal Philips N.V. (Netherlands). The company employed around 32,914 people worldwide as of September 2015.

FIGURE 54 OSRAM LICHT AG: COMPANY SNAPSHOT



Note: Exchange rates for EUR to USD for the years 2014, 2015, and 2016 are 1.357, 1.148, and 1.107, respectively.

Note: OSRAM discontinued its lamps segment operations in 2016 because of which the revenue is lesser than the previous two years.

Source: Company Website, Annual Reports, and SEC Filings

12.4.2 PRODUCTS OFFERED

The company offers the following products:

Category	Product
LEDs for General Lighting	<ul style="list-style-type: none"> • DURIS® E series (2, 3, 5) • DURIS® P series (5, 8, 10) • DURIS® S series (2, 5, 5E, 8, 10) • OSLON® Square • OSLON® SSL series (White, Colors) • SOLERIQ® series (L,S) • Golden DRAGON Plus series (White, Colors)

Source: Company Website, Annual Reports, and SEC Filings

12.4.3 RECENT DEVELOPMENTS

Date	Approach	Description
April 2016	Product Development	OSRAM expanded its LED floodlight range with the launch of the Floodlight 20 Maxi LED. The flexible floodlight series is available in four sizes and with luminaire luminous flux levels from 3,000 to 100,000 lumens.
May 2015	New Product Launch	OSRAM's opto semiconductors segment announced the launch of a new LED to extend its Duris product portfolio. This new LED operates in the low-to-medium output range and offers a high typical luminous efficacy of 160lm/W.
April 2015	New Product Launch	OSRAM's opto semiconductors segment added P2W 01 LED to the Osram Ostar Projection series product line. This new LED offers trouble-free operations and is ideal for 24/7 applications.
December 2014	New Product Launch	OSRAM Licht AG announced the launch of smart lighting for Christmas trees using its LED technology. This Lightify light chain can generate around 16 million different colors and can be controlled by a smartphone app.
December 2014	New Product Launch	OSRAM's opto semiconductors segment launched a new LED for stage lighting. This new product generates lumen output which is twice that of OSRAM's earlier products.

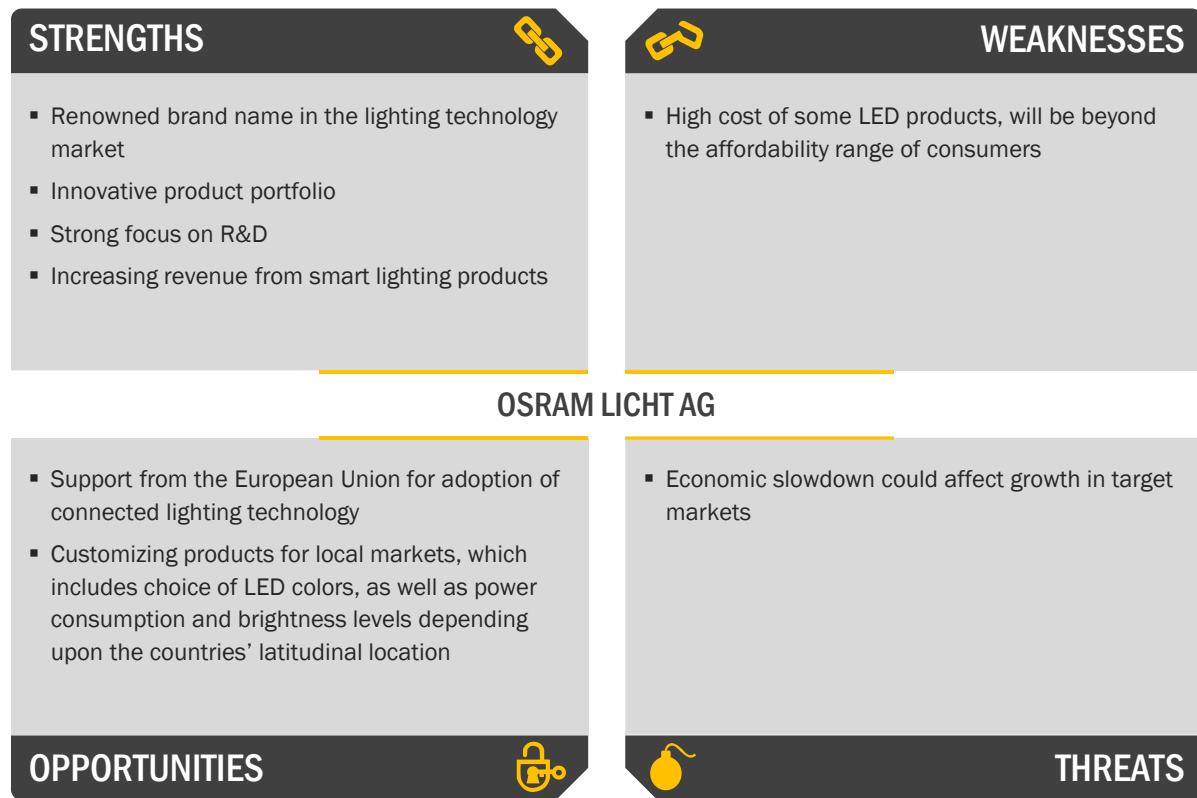
Source: Company Website, Annual Reports, and SEC Filings

12.4.4 MNM VIEW

OSRAM announced its intention to increase its focus on the automotive lighting, smart lighting, and LED components market. By adopting the strategy of reorganizing business segments and eliminating underperforming businesses, the company seeks to target business-to-business (B2B) and semiconductor markets where there is scope to earn higher profit margins. The company is expanding its LED chip-based investments and facilities in Germany and Malaysia. R&D and innovation are its prime strengths and the company is expected to rely on that for future expansions in the market. It has launched several new products for automotive lighting, smart lighting, and other lighting applications.

12.4.4.1 SWOT analysis

FIGURE 55 OSRAM LICHT AG: SWOT ANALYSIS



Source: Company Website, Industry Journals, and MarketsandMarkets Analysis

12.5 CREE, INC.

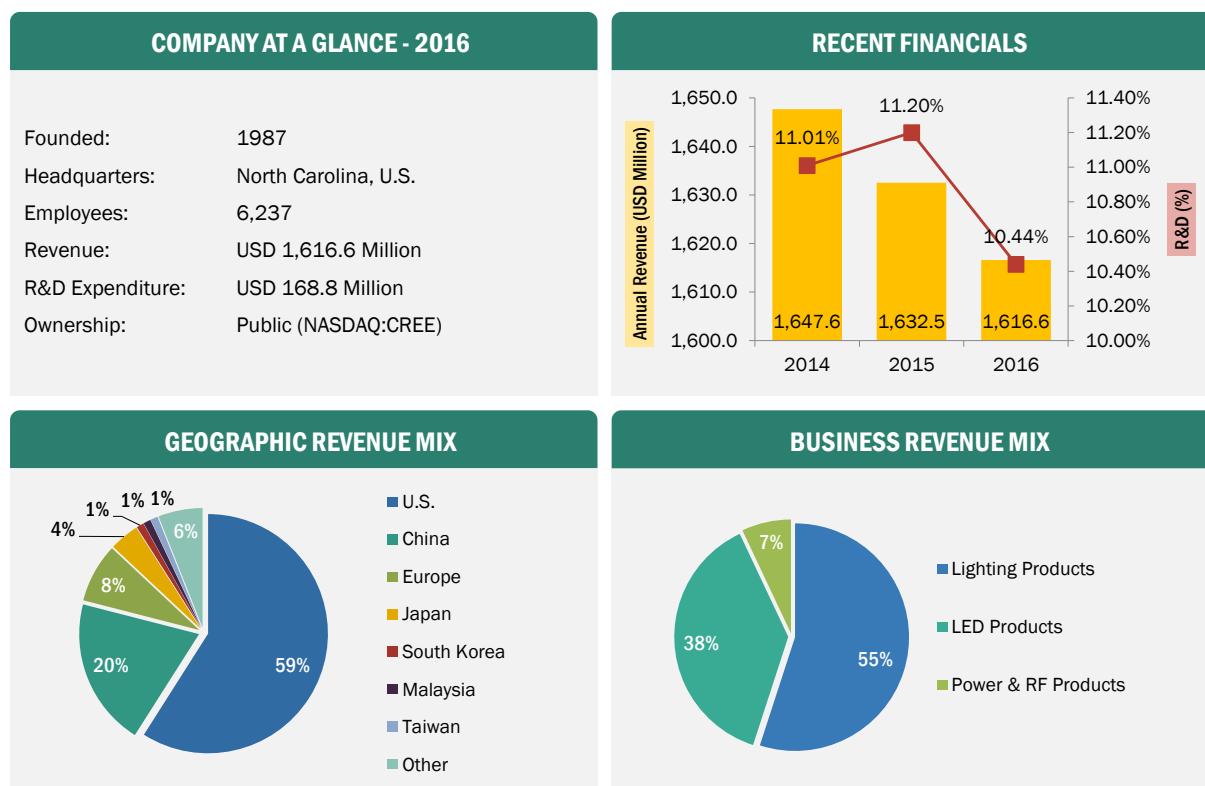
12.5.1 BUSINESS OVERVIEW

Cree, Inc. is primarily engaged in the production of LEDs and LED-related products such as infrared emitters and receivers and power devices. The company provides semiconductor devices based on silicon carbide (SiC), gallium nitride (GaN), and related wide-bandgap compounds. Cree mainly serves the applications of industrial, power, solar, wind, military, and aerospace and defense sectors through its products such as solar inverters, solar converters, RF devices, and military communication devices. The total number of employees working in the company as of 2016 was above 6,237. The company operates in North America, Europe, and APAC regions (China, South Korea, Japan, Malaysia, and Taiwan). Cree was founded in 1987 and has its headquarters in Durham, North Carolina, U.S.

Currently, it is the only major player in the opto-semiconductors industry which manufactures LEDs based on SiC substrate on a massive scale. Moreover, it is one of the major players having its own research-oriented subsidiaries. It primarily conducts research on the use of wide-bandgap materials alongside SiC in LEDs and related technologies and now also focuses on SiC power semiconductors, starting with SiC power discrete.

The major subsidiaries of Cree, Inc. are Cree LED Lighting Solutions (NC), Cree Research Triangle Park Technology Center (NC), Cree Santa Barbara Technology Center (U.S.), Cree Hong Kong Limited (Hong Kong), Cree Japan Limited (Japan), and Cree Europe GmbH (Germany).

The major competitors of Cree, Inc. are Nichia Corporation (Japan), Epistar Corporation (Taiwan), Toyoda Gosei Co., Ltd. (Japan), OSRAM Semiconductor GmbH (Germany), Philips Lumileds Lighting Company LLC (U.S.), Avago Technologies Limited (U.S.), Edison Opto Corporation (Taiwan), Kingbright Corporation (U.S.), Samsung LED Company (South Korea), Seoul Semiconductor Co., Ltd. (South Korea), Acuity Brands Lighting, Inc. (U.S.), Cooper Lighting (Ireland), General Electric Company (U.S.), and Royal Philips Electronics N.V. (Netherlands).

FIGURE 56 CREE, INC.: COMPANY SNAPSHOT

Source: Company Website, Annual Reports, SEC Filings, and MarketsandMarkets Analysis

12.5.2 PRODUCTS OFFERED

The company offers the following products:

Category	Product
Outdoor Lighting	<ul style="list-style-type: none"> • Cree Edge™ High Output • OSQ™ Series • XSP High Output Series • Cree Edge™ High Output • XSP Series • Cree Edge™ Series • Cree Edge™ Pathway • LEDway® High Output Series • Cree Edge™ High Output • Cree Edge™ Transportation Mount • RUL Series • DPT Series • Post-Top Upgrade Kit • CPY Series • 228 Series™ • 304 Series™ • Cree Edge™ Series

<p>Indoor Lighting</p> <ul style="list-style-type: none"> • IG Series • VG Series • ESA Series • Essentia® by Cree Downlights • ESA Series Surface Cylinder • KR Series • CR Series • DR Series • LR Series • CR Series • LR Series • Essentia® by Cree Flat Panel • ZR Series • UR Series • CR24 UPKIT • LS Series • Essentia® by Cree LED Surface Wrap • CR Series Light Engine • WS Series • CS Series • LN Series • CXB Series • HXB Series • Cree Edge™ Series • Cree Edge™ High Output • 304 Series™ • OL Series • A19 Series • A21 Series • B13 Series • PAR38 Series • BR Series • LBR Series • MR16 Series • LM Series • LRP Series • PAR30 Series • Essentia® by Cree Track • Essentia® by Cree LED Wall Wash Track Head
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12.5.3 RECENT DEVELOPMENTS

Date	Approach	Description
August 2016	New Product Launch	Cree launched a new 13,000-lumen Cree canopy luminaire which offers superior illumination and industry-leading efficiency as well as easy installation and lower total cost of ownership for better light experiences.
August 2016	New Product Launch	Cree, Inc. introduced the XLamp MHB-B LED, a new high-power LED that provides a more effective way to deliver low-cost systems for high-lumen, high-efficiency applications designed to meet the new DesignLights Consortium (DLC) 4.0 Premium requirements.
July 2016	Agreement	Cree, Inc. and Avnet, Inc. announced a strategic agreement that expands coverage in the Americas for the distribution of Cree's comprehensive portfolio of innovative LED components including chip-on-board and LED modules.
June 2016	New Product Launch	Cree, Inc. expanded its industry-leading portfolio of LEDs optimized for horticulture lighting with the introduction of the new Cree XLamp XQ-E Photo Red LED. The XQ-E Photo Red LED is capable of providing very high levels of growth-promoting light wavelengths from a footprint that is less than one-third the size of its closest competitor with similar output.
September 2015	New Product Launch	Cree, Inc. introduced a new LED bulb. This new Cree LED bulb delivers better light with better performance and longer life than traditional bulbs.

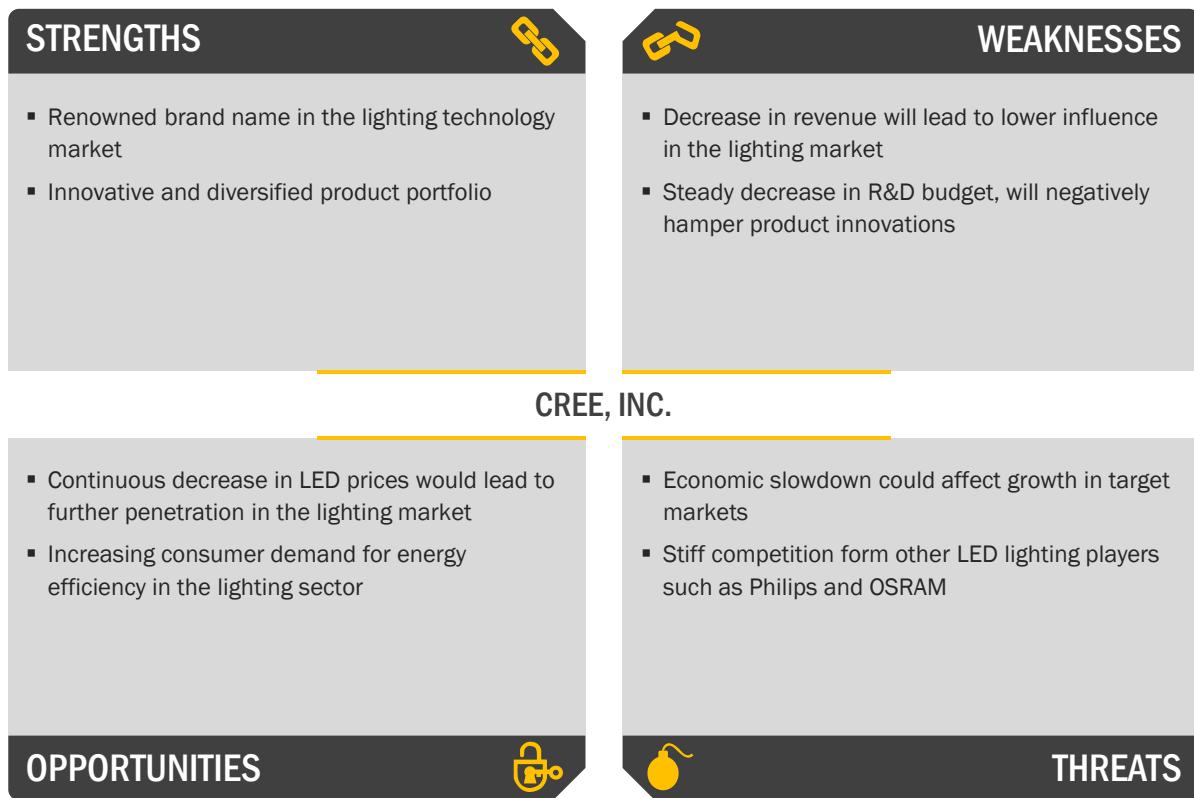
Source: Press Releases and MarketsandMarkets Analysis

12.5.4 MNM VIEW

Cree's 30 years of experience in the lighting segment has made it an undisputed leader in the LED lighting market. Over the last three years, it has launched innovative products for the lighting segment focusing on energy and cost-efficiency. It also follows the strategy of agreements with other organizations to gain geographic foothold as well as market share in a particular region. For example, Cree signed an agreement with Avnet, Inc. to expand its coverage in the Americas for the distribution of their innovative LED components.

12.5.4.1 SWOT analysis

FIGURE 57 CREE, INC.: SWOT ANALYSIS



Source: Company Website, Industry Journals, and MarketsandMarkets Analysis

12.6 COOPER INDUSTRIES, INC.

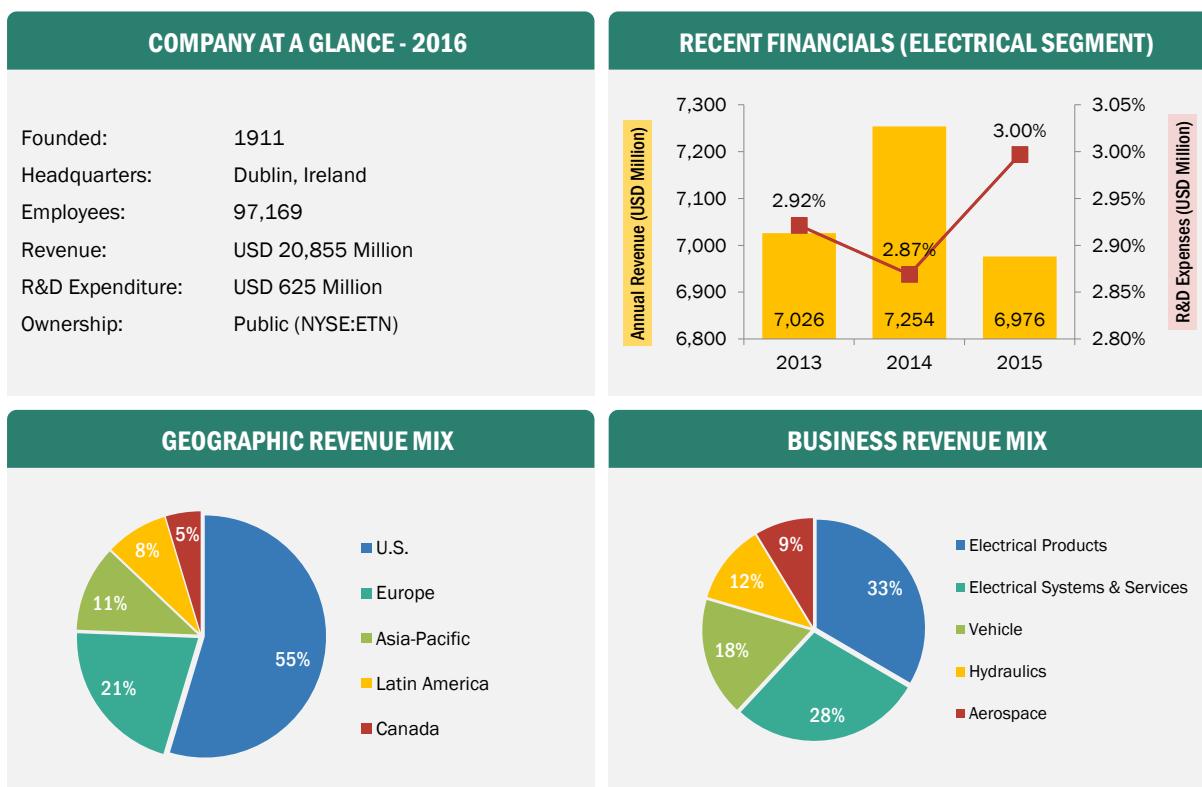
12.6.1 BUSINESS OVERVIEW

Cooper Industries, Inc. is a worldwide electrical systems manufacturer. It specializes in the manufacturing of several lighting and electrical solutions worldwide. It offers a range of innovative and reliable indoor and outdoor LED lighting and controls solutions.

Cooper was founded in 1833, Mount Vernon, Ohio, U.S. Cooper now operates as a fully owned subsidiary of Eaton Corporation under its electrical segment, after it was acquired by the latter in November 2012 for USD 13 billion. It is presently headquartered in Dublin, Ireland and employs more than 95,000 people.

The major competitors of Cooper Industries, Inc. are OSRAM Sylvania (U.S.), Acuity Brands Lighting, Inc. (U.S.), Cree, Inc. (U.S.), and GE Lighting (U.S.), among others.

FIGURE 58 COOPER INDUSTRIES, INC.: COMPANY SNAPSHOT



Source: Company Website, Annual Reports, and MarketsandMarkets Analysis

12.6.2 PRODUCTS OFFERED

Some of the products that the company offers are as follows:

Category	Product
LED Lighting	<ul style="list-style-type: none"> • ACN/ARC/CLB Generation Series HID/LED • AL3150LPC Series • ASYX 2 - QP - Quad Pendant • CNC Concise LED • FCT LED Surface Confinement • FMR LED Recessed Flange Confinement • LC32 – LED • SNLED Series • 121-S LED Series • 141-P Series • 23DP LED Straight and Narrow • ArcLine LED Series • AEL2 Series • ALL-PRO LED Wall Pack Security Floodlight • ASYX 2 - SP - Single Pendant • VPL Valet LED • XNV LED

Source: Company Website, Annual Reports, and MarketsandMarkets Analysis

12.6.3 RECENT DEVELOPMENTS

Date	Approach	Description
August 2016	Product Development	Eaton announced the expansion of the Lumark Night Falcon LED Floodlight Luminaire family. These LEDs are available in multiple wattages. The Night Falcon series is designed to replace high-intensity discharge (HID) lamps with power of 70W-1,000W range, mainly used for floodlighting applications.
August 2016	New Product Launch	Eaton announced the launch of the Dim-to-Warm (D2W) technology in its portfolio of Halo LED recessed downlighting product lines for use of residential and commercial spaces. The technology incorporated in it mimics the function of an incandescent halogen lamp source when it is dimmed, from a white LED color temperature to a warm, soft glow.
July 2016	Collaboration	Eaton announced a collaboration with NuLEDs, Inc., a leader in Power-over-Ethernet (PoE) lighting systems, for the making of smart buildings.
March 2015	New Product Launch	Eaton introduced the Halo ALLSLOPE LED downlight system in residential, hospitality, retail, and institutional buildings. This new system features unique interchangeable beam-forming optics, full-range dimming, and numerous color temperatures and trim options, besides providing greater energy savings.
September 2014	Contract	Eaton's Cooper Lighting Division signed a contract to install over 5,000 LED luminaires at the Denver International Airport (U.S.). This project aims to improve optical performance and energy efficiency at the airport by increasing the visibility of flight information and passenger directions.

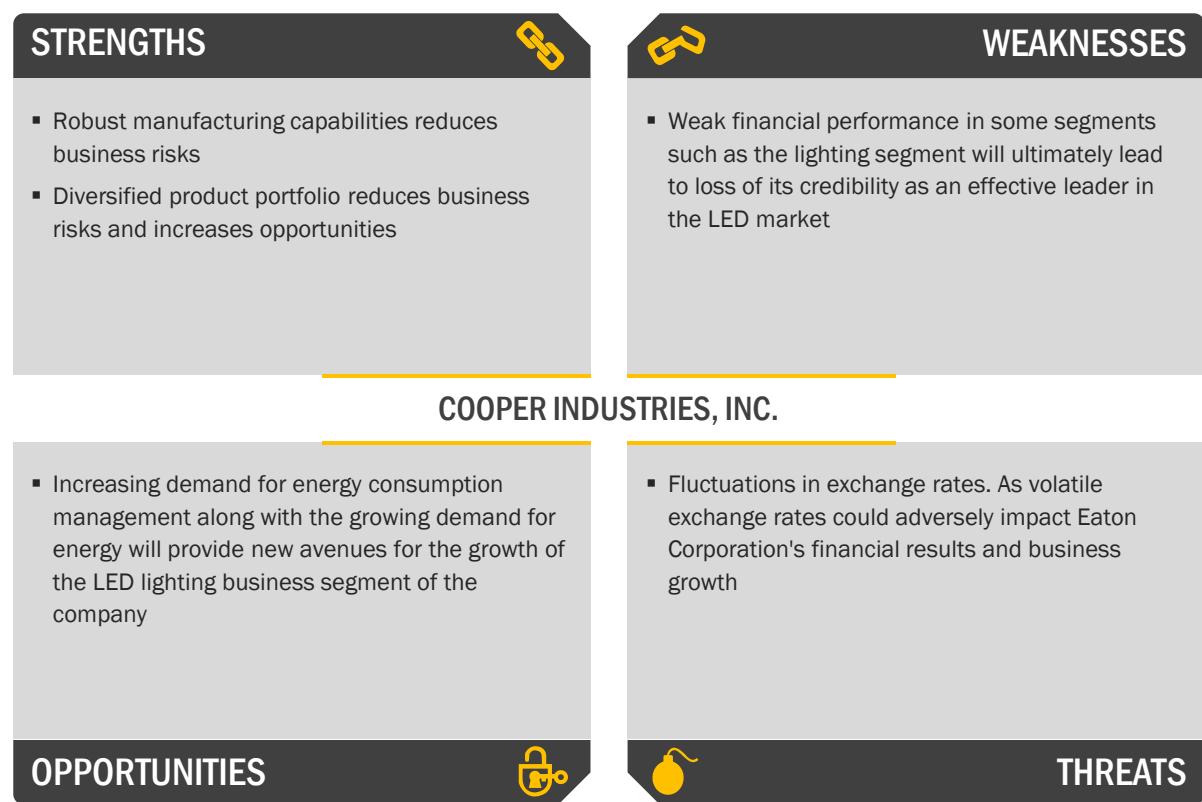
Source: Company Website, Annual Reports, and MarketsandMarkets Analysis

12.6.4 MNM VIEW

The company focuses on geographic expansion to increase its footprint. It has acquired many companies to capitalize on their technologies and strategies. For instance, it acquired the distribution business of Gycom Electricals (Sweden) in Sweden, Finland, and Denmark to expand its business in these countries. The company may launch new products and increase its portfolio of electrical products to gain a competitive advantage in the market.

12.6.4.1 SWOT analysis

FIGURE 59 COOPER INDUSTRIES, INC.: SWOT ANALYSIS



Source: Company Website, Industry Journals, and MarketsandMarkets Analysis

12.7 VIRTUAL EXTENSION

12.7.1 BUSINESS OVERVIEW

Virtual Extension was founded in 2000 and has its headquarters in Beit Dagan, Israel. The company specializes in wireless control and monitoring for the industrial market, using a mesh networking-based IoT technology in the sub-1GHz ISM frequency range.

A member of DALI, Virtual Extension currently focuses on high-performance wireless lighting control, mainly in street, professional, and industrial lighting, as well as in smart metering and other innovative smart city controls. The company's control solutions allow to immediately replace wires by wireless solutions for most modern sensors and luminaires, including DALI, using its own wireless mesh networking technology called VEmesh that is based on synchronized flooding.

12.7.2 PRODUCTS OFFERED

The company offers the following products:

Category	Product
LED Smart Lighting	<ul style="list-style-type: none"> • Bridge (wireless—LED and sensors) • NEMA Bridge • Gateway (wireless—controller) • DIN-rail Gateway • VEmesh Toolkit (for deployment facilitation)

Source: Company Website and MarketsandMarkets Analysis

12.7.3 RECENT DEVELOPMENTS

Date	Approach	Development
June 2016	New Product Launch	<p>Virtual Extension released a new VEmesh D2D Bridge version that enables its customers to extend the convenience of replacing DALI wiring by wireless. The existing versions of VEmesh D2D Bridge have been offering for long time the convenience, flexibility, and cost savings to users of standard devices complying with DALI standard, and lately also input devices.</p>
November 2016	New Product Launch	<p>Virtual Extension continues to innovate in high-performance wireless lighting control, with networks that expand its wireless extension into DALI 2 reign. Using the same innovative VEmesh technology that allows the replacement of wiring by wireless for the previous generation of DALI controllers, LED drivers, and other control gears, Virtual Extension complements the emergence of the new DALI input devices and application controllers with the modern, convenient, and easy-to-deploy wireless connectivity.</p>

Source: Company Website and MarketsandMarkets Analysis

COMPANY AT A GLANCE

Founded:	2000
Headquarters:	Beit Dagan, Israel
Ownership:	Private

Note: This is a privately held company. Hence no financial information is available in the public domain

Source: Company Website

12.8 DIALIGHT PLC

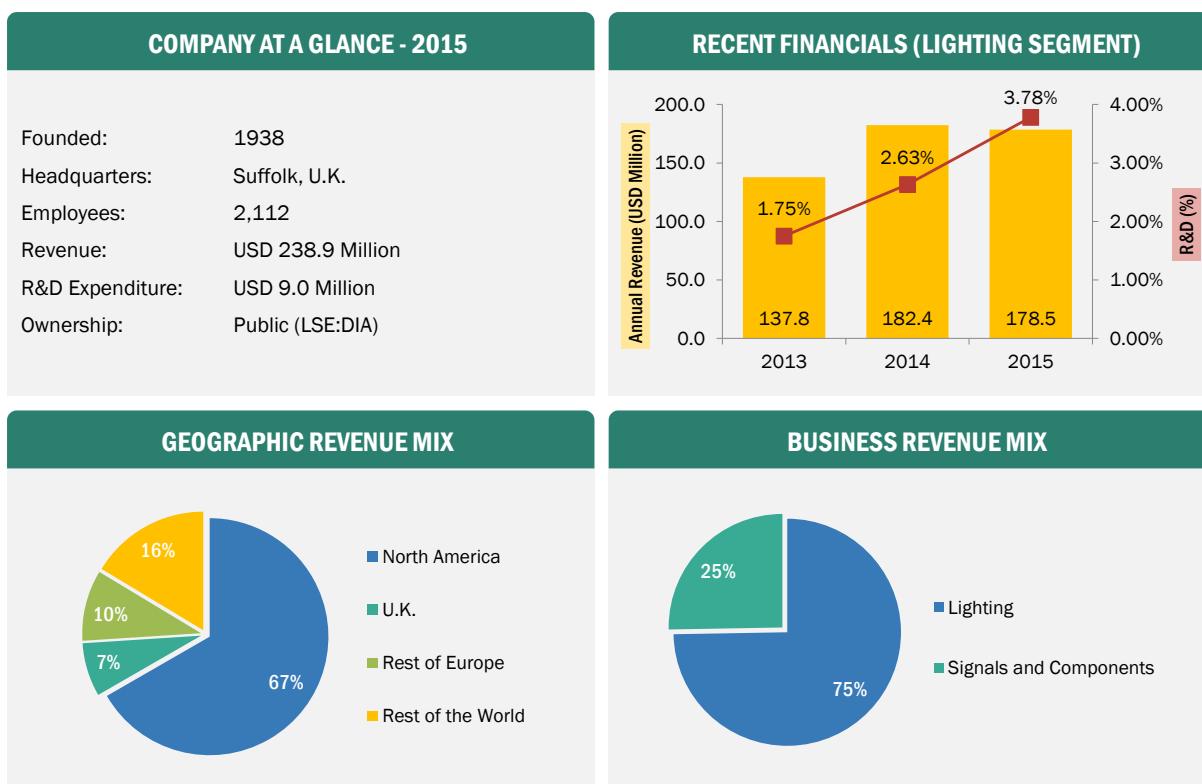
12.8.1 BUSINESS OVERVIEW

Dialight plc is a worldwide LED manufacturing company, based in Suffolk, U.K. It is involved in the manufacturing of innovative lighting products focusing on light output, efficacy, and reliability for their line of lighting fixtures which are specifically designed for industrial, commercial, and hazardous location and transportation and public infrastructure applications.

It operates in two business segments, namely, lighting and signals and components. The former segment is involved in the production and manufacturing of LED products, while latter is involved in the manufacturing of controlling components of LED products. As of 2015, it had an employee strength of 2,112 people.

The major competitors of Dialight are OSRAM Sylvania (U.S.), Cree, Inc. (U.S.), and GE Lighting (U.S.), among others.

FIGURE 60 DIALIGHT PLC: COMPANY SNAPSHOT



Note: Exchange rates for GBP to USD for the years 2013, 2014, and 2015 are 1.66, 1.56, and 1.48, respectively.

Source: Company Website, Annual Reports, and MarketsandMarkets Analysis

12.8.2 PRODUCTS OFFERED

The company offers the following products:

Category	Product
LED Lighting Solutions	<ul style="list-style-type: none"> Vigilant® LED High Bay Lighting Vigilant® LED High Bay Fixtures – CE Vigilant® LED Floodlight – UL

- Vigilant® LED Floodlight – CE
- DuroSite® LED High Bay Fixtures – UL/CSA
- DuroSite® LED High Bay Fixtures – DC
- DuroSite® LED High Bay Luminaires – CE
- DuroSite® LED Floodlight Fixtures – UL/CSA
- DuroSite® LED Floodlight Luminaires – CE
- DuroSite® LED Area Lights – UL
- DuroSite® LED Area Lights – CE
- DuroSite® RTO LED Area Light – UL/CSA
- DuroSite® LED Linear Fixtures – UL/CSA
- DuroSite® LED Linear Luminaires – CE
- DuroSite® LED End-to-End Linear Fixture – UL/CSA
- DuroSite® LED End-to-End Linear Fixture – NSF
- DuroSite® LED End-to-End Linear Fixture – CE
- DuroSite® LED Low Bay Fixtures – UL
- DuroSite® LED Low Bay Fixtures – CE
- DuroSite® LED Wallpack Fixtures – UL
- DuroSite® LED Bulkhead Luminaires – CE
- StreetSense® LED Street Light
- StreetSense® LED Street Light – ATEX/IECEx Zone 2
- StreetSense® LED Roadway Sign Light
- SafeSite® LED High Bay Fixture – High Efficiency – UL844
- SafeSite® LED High Bay Fixture – High Efficiency – ATEX/IECEx
- SafeSite® LED High Bay Fixtures – UL844
- SafeSite® LED High Bay Luminaires – ATEX/IECEx
- SafeSite® LED High Bay Fixtures – INMETRO
- SafeSite® LED Floodlight Fixtures – UL844
- SafeSite® LED Floodlight – ATEX/IECEx
- SafeSite® LED Area Light Fixtures – UL844
- SafeSite® LED Area Light Luminaires – ATEX/IECEx
- SafeSite® LED Area Lights – INMETRO
- SafeSite® RTO LED Area Light – Class I, Div. 2
- SafeSite® LED Linear Fixtures – UL844
- SafeSite® LED Linear Fixture – ATEX/IECEx
- SafeSite® LED End-to-End Linear Fixture – UL 844
- SafeSite® LED Wallpack Fixtures – UL844
- SafeSite® LED Bulkhead Luminaires – ATEX/IECEx
- SafeSite® LED Bulkhead Fixtures – INMETRO

Source: Company Website, Annual Reports, and MarketsandMarkets Analysis

12.8.3 RECENT DEVELOPMENTS

Date	Approach	Description
October 2016	New Product Launch	Dialight announced the launch of its new product—the 670 series LED panel mount indicators with high visibility, with a wide range of sizes and operating voltage in high-durability housings.
April 2016	Partnership	Dialight announced that it joined the Rockwell Automation PartnerNetwork for Encompass, a product referencing program. The partnership with Rockwell Automation systems would help different industrial facilities in leveraging the energy- and maintenance-saving benefits of Dialight high-performance LED lighting.
January 2016	New Product Launch	Dialight announced the launch of the new Vigilant® LED dual red/white strobe with infrared (IR) obstruction lighting system. The dual IR flash heads of the lighting system are FAA AC 150/5345-43G and Engineering Brief No. 67D standards certified. The IR LEDs help the pilots during night operation for flights to enhance visibility and safety, including those who use night vision goggles (NVGs).
September 2015	New Product Launch	Dialight released the new Vigilant® LED Floodlight product for the floodlight market. It delivers up to 55,000 lumens, meeting the needs of industrial applications. The Vigilant Floodlight also consumes less than half the energy of conventional HID systems, in a 30% lighter fixture.
June 2015	New Product Launch	Dialight announced the launch of its new 15,000-lumen DuroSite® Floodlight, certified by UL, CE, and Safesite® C1D2 standards. The higher lumen Floodlight is capable of replacing up to 400W traditional HID lighting fixtures and sets a benchmark for future energy-efficient illumination for industrial and hazardous applications worldwide.

Source: Company Website, Annual Reports, and MarketsandMarkets Analysis

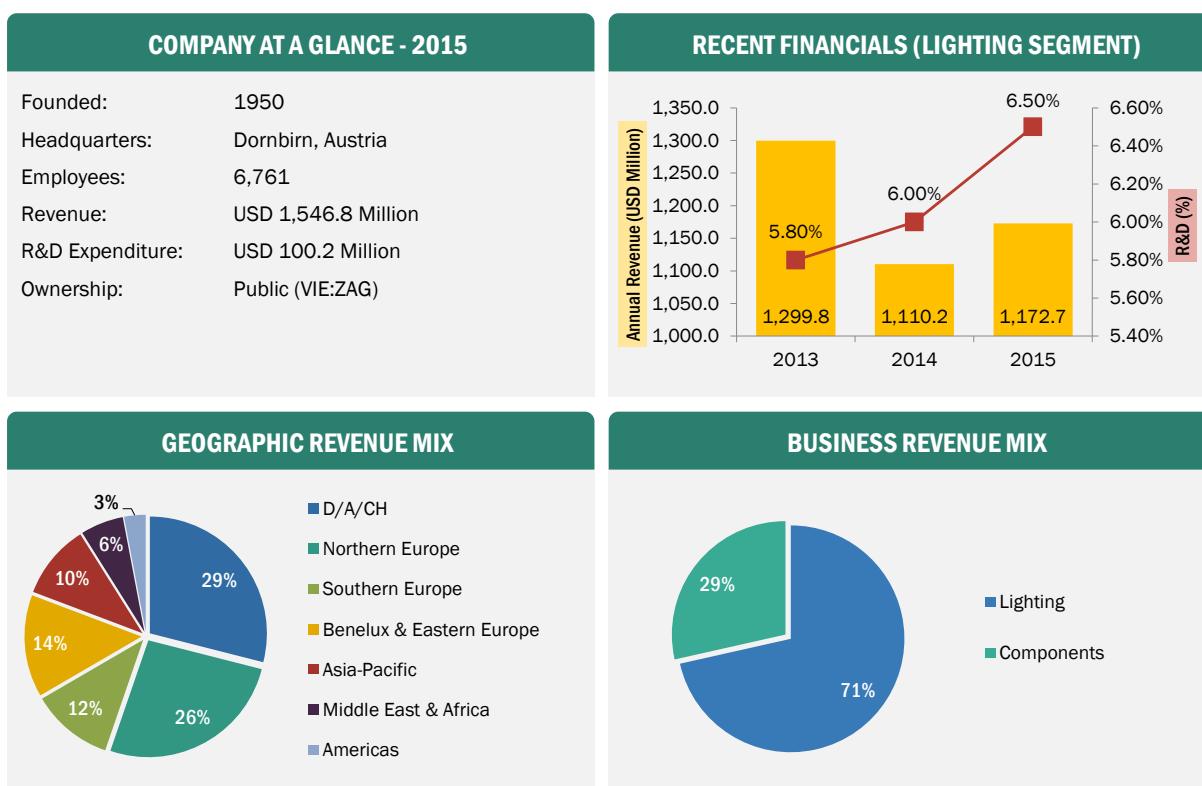
12.9 ZUMTOBEL GROUP AG

12.9.1 BUSINESS OVERVIEW

Zumtobel Group AG is one of the leading companies manufacturing and supplying lighting solutions and components. The company operates its business through two segments, namely, lighting and components. The lighting business is conducted by subsidiaries such as Zumtobel Lighting GmbH (Austria), Thorn Lighting Ltd. (U.K.), and Reiss Lighting GmbH (Germany). Zumtobel Lighting GmbH (Austria) offers a range of premium luminaires and lighting control systems for applications in indoor lighting, outdoor lighting, and residential sector. Thorn Lighting Ltd. (U.K.) is a supplier of indoor and outdoor lighting with integrated controls. Reiss Lighting GmbH offers luminaires with high protection. The components segment is operated by Tridonic GmbH & Co KG (Austria).

It manufactures hardware and software for lighting systems. The application areas of lighting solutions offered by the company include offices, educational facilities, retail sector, hotels, healthcare facilities, and industrial sector. It has sales offices and partners in around 90 countries and has 14 manufacturing plants globally. Founded in 1950 and headquartered in Dornbirn, Austria, it had an employee strength of 6,761 as of 2015.

FIGURE 61 ZUMTOBEL GROUP AG: COMPANY SNAPSHOT



Note: Exchange rates for EUR to USD for the years 2013, 2014, and 2015 are 1.3850, 1.1215, and 1.1403, respectively.

Source: Company Website, Annual Reports, and MarketsandMarkets Analysis

12.9.2 PRODUCTS OFFERED

The company offers the following products:

Category	Product
LED Lighting	<ul style="list-style-type: none"> • Track and spots • Modular lighting systems • Downlights • Recessed luminaires • Surface-mounted and pendant luminaires • Free-standing and wall-mounted luminaires • Continuous-row systems and individual batten luminaires • High-bay luminaires • Outdoor luminaires

Source: Company Website, Annual Reports, and MarketsandMarkets Analysis

12.9.3 RECENT DEVELOPMENTS

Date	Approach	Description
September 2016	Contract	Zumtobel received a contract from FARO Foundation located in Windisch, Switzerland, for providing NOW service (LaaS) for its new office. This contract would provide benefits to FARO such as improved lighting quality and energy efficiency.
August 2016	New Product Launch	Zumtobel launched ECOOS LED, a continuous-row, pendant, and surface-mounted luminaire. It has direct, indirect, and lateral lighting features, which ensures efficient light at the desk and at the same time allows vertical illuminance.
June 2015	Contract	Zumtobel signed a contract with AVEVE (Belgium) to provide LaaS.

Source: Company Website, Annual Reports, and MarketsandMarkets Analysis

12.10 SAMSUNG

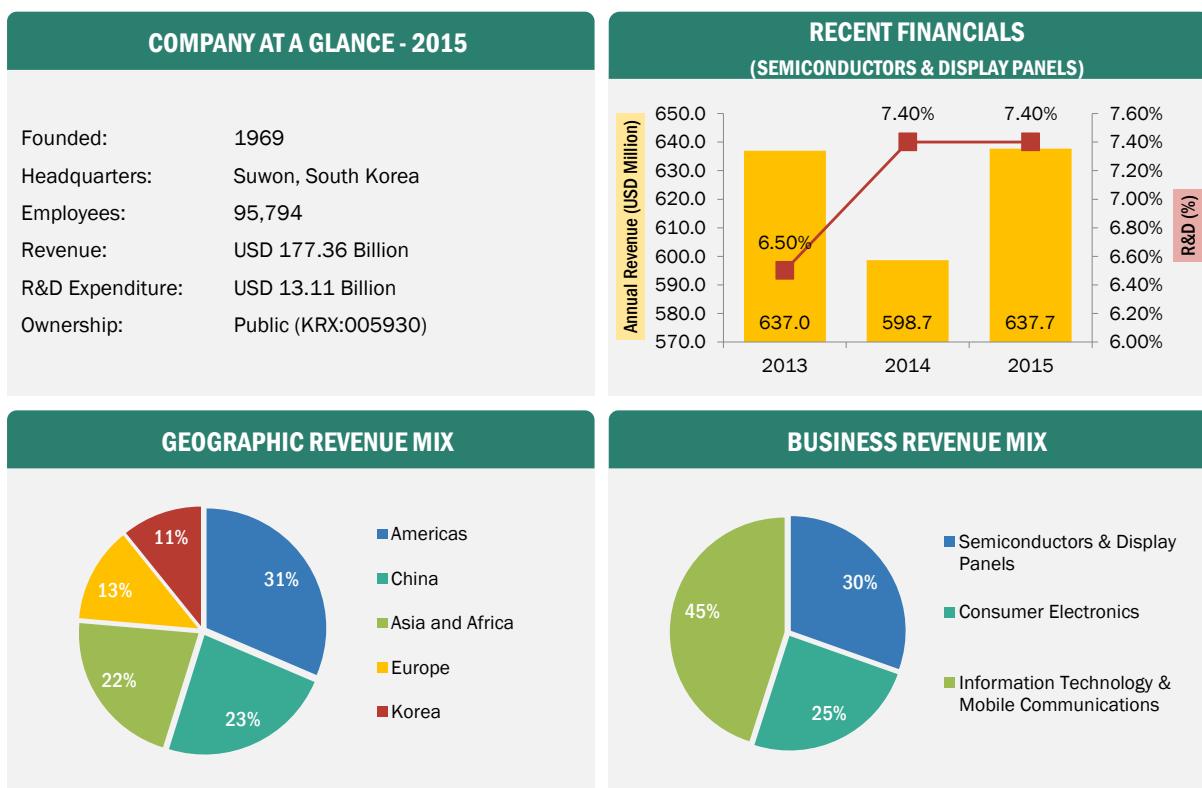
12.10.1 BUSINESS OVERVIEW

Samsung Electronics Co., Ltd. engages in the manufacturing and selling of electronics and computer peripherals. The company operates its business through the following divisions: consumer electronics, information technology and mobile communications, and device solutions. The semiconductors and display panels division provides LED modules and engines for street, office, and retail lighting solutions along with smart lighting technologies. The device solutions business division includes semiconductors and display panels. It was founded on January 13, 1969 and is headquartered in Suwon, South Korea.

Few of its subsidiaries include Samsung Display Co., Ltd. (South Korea), Samsung Electronic Communication (Shanghai) Co., Ltd. (South Korea), Samsung Electronics (China) Digital Printing Co., Ltd. (China), Samsung Electronics (UK) Limited, and Samsung Electronics Taiwan Co., Ltd. (Taiwan), among others.

The company's major competitors are LG Display Co., Ltd. (South Korea), Sharp Corporation (Japan), Sony Corporation (Japan), Panasonic Corporation (Japan), AU Optronics Corp. (Taiwan), NEC Display Solutions (Japan), Planar Systems, Inc. (U.S.), ADFLOW Networks (Canada), and Omnivex Corporation (Canada), among others.

FIGURE 62 SAMSUNG: COMPANY SNAPSHOT



Note: Exchange rates for KRW to USD for the years 2013, 2014, and 2015 are 0.00094, 0.00091, and 0.00085, respectively.

Source: Company Website, Annual Reports, and MarketsandMarkets Analysis

12.10.2 PRODUCTS OFFERED

The company offers the following products:

Category	Product
High Power LED Components	<ul style="list-style-type: none"> • LH351D • LH351B
Mid Power LED Components	<ul style="list-style-type: none"> • LM301A • LM302A • LM302B • LM28xB Series • LM561C • LM561B Plus • LM561B
Chip-On-Board (COB) Components	<ul style="list-style-type: none"> • Standard COB • Vivid Color COB • Small LES COB • D Series
Chip-Scale Package (CSP) Components	<ul style="list-style-type: none"> • LM101A • LM102A • LM131A • LH141A
LED Engine	<ul style="list-style-type: none"> • Ambient Light Engine • Downlight Engine • Outdoor Engine • LED Driver

Source: Company Website, Annual Reports, and MarketsandMarkets Analysis

12.10.3 RECENT DEVELOPMENTS

Date	Approach	Description
October 2016	Product Development	Samsung announced the launch of its high-power LED package line-up which offers a complete portfolio for high-intensity light applications.
October 2016	New Product Launch	Samsung Electronics Co., Ltd. announced a new line-up of chip-scale package (CSP) LED modules which are designed for spotlights and downlights that feature color tunability and increased design compatibility.
September 2016	New Product Launch	Samsung Electronics Co., Ltd. announced the launch of H-series Gen 3, a new line-up of LED linear modules which features high efficacy and allows easy replacement of fluorescent lights with LED lamps.
March 2016	Collaboration	Samsung Electronics Co., Ltd. and Daintree Networks collaborated on joint solutions which involves Samsung's smart lighting module (SLM). Samsung's SLM, which will be integrated with LED luminaires from lighting OEMs, provides greater intelligence through device-level processing and also enhanced connectivity through multiple embedded communications technologies, including the open standard ZigBee protocol.
March 2016	Partnership	Samsung Electronics Co., Ltd. and Silver Spring Networks, Inc. (NYSE:SSNI) announced a partnership to develop a networked LED street lights solution, which would help cut costs and simplify connected lighting componentry for luminaire manufacturers.

Source: Company Website, Annual Reports, and MarketsandMarkets Analysis

12.11 SHARP CORPORATION

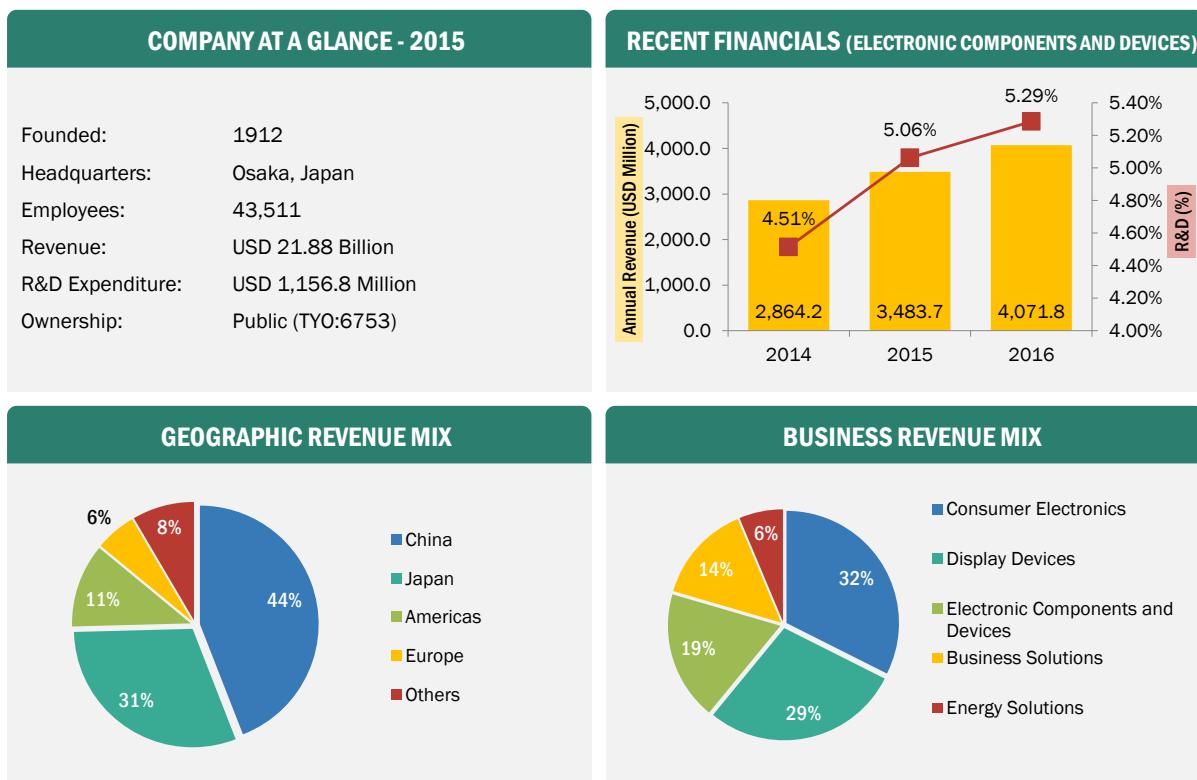
12.11.1 BUSINESS OVERVIEW

Sharp Corporation was established in 1912 and has its headquarters in Osaka, Japan. It was formerly known as Hayakawa Electric Industry Co., Ltd. and was renamed in 1970. Sharp is engaged in the manufacturing and sale of electric telecommunication, electrics, and electronic equipment. The company manufactures chip-on-board (COB) LEDs under its electronic components and devices segment. The company is one of the world's largest manufacturers of photovoltaic solar cells. As of 2016, the company has 43,511 employees worldwide.

The company operates in Japan, U.S., Middle East and Africa, Asia, Europe, and Oceania with subsidiaries such as Sharp Electronics (Europe) GmbH (Germany), Sharp Electronics Corporation (U.S.), Sharp Electronics SA (France), Sharp Manufacturing Company Limited (Thailand), and Sharp (Phils.) Corporation (Philippines). The company focuses on the development of future display technology for televisions and smartphones, and aims to have a tie-up with market leaders in IT and telecom such as Apple Inc., Google Inc., and Microsoft Inc.

The company's major competitors are Samsung Electronics Co., Ltd. (South Korea), LG Display Co., Ltd. (South Korea), Sony Corporation (Japan), Panasonic Corporation (Japan), AU Optronics Corp. (Taiwan), NEC Display Solutions (Japan), Planar Systems, Inc. (U.S.), ADFLOW Networks (Canada), and Omnivex Corporation (Canada), among others.

FIGURE 63 SHARP CORPORATION: COMPANY SNAPSHOT



Note: Exchange rates for JPY to USD for the years 2014, 2016, and 2016 are 0.00973, 0.00836, and 0.00889, respectively.

Source: Company Website, Annual Reports, and MarketsandMarkets Analysis

12.11.2 PRODUCTS OFFERED

The company offers the following products:

Category	Product
LED Chip on Boards	<ul style="list-style-type: none"> • Mega Zenigata Chip on Board (COB) • Mini Zenigata Chip on Board (COB)

Source: Company Website, Annual Reports, and MarketsandMarkets Analysis

12.11.3 RECENT DEVELOPMENTS

Date	Approach	Description
August 2013	Agreement	Sharp Corporation and OSRAM GmbH announced that they have entered into a patent cross-licensing agreement covering LEDs and laser diodes. The agreement grants either parties the right to use inventions related to LED and laser diodes covered by the patents owned by the respective companies around the world. It is expected that this would spur their R&D and contribute to further advances in LEDs, laser diodes, and related industries.

Source: Company Website, Annual Reports, and MarketsandMarkets Analysis

13 APPENDIX

13.1 INSIGHTS OF INDUSTRY EXPERTS



13.2 DISCUSSION GUIDE

- Q. 1.** Q1. What are your views on the growth perspective of the global LED lighting market? What is the current scenario and how it will grow in the future?

Primary's Viewpoint: _____

- Q. 2.** What was the size of the global LED lighting market in 2015 and what would be the CAGR for the next six years?

Region	Market Size (USD Million)/ Market Share (%), 2015	CAGR (2016–2022)
North America		
Europe		
Asia-Pacific		
Rest of the World (ROW)		
Total	100%	

Primary's Viewpoint: _____

- Q. 3.** What is the percentage contribution of the following components in the LED lighting market? What are the key factors that would drive the fastest-growing segments of the market in the next five years?

Product Type	Market Size (USD Million)/Market Share (%), 2015	Market Size (USD Million)/Market Share (%), 2022	CAGR (2016–2022)
LED bulbs			
Luminaires			
Total	100%	100%	

Primary's Viewpoint: _____

- Q. 4.** What is the percentage contribution of the following replacement lamp types in the overall LED lighting market? What are the key factors that would drive the fastest-growing segments of the market in the next five years?

Replacement Lamp Type	Ranking	Market Size (USD Million)/Market Share (%), 2015	Market Size (USD Million)/ Market Share (%), 2022	CAGR (2016-2022)
A-19				
T-Lamps				
Reflectors				
MR-16				
Others (Decorative Lamps and Low/High-Bay Lamps)				
Total		100%	100%	

Primary's Viewpoint: _____

- Q. 5.** What is the percentage contribution of the following end-use applications in the LED Lighting Market? What are the key factors that would drive the fastest-growing segments of the market in the next five years?

End-Use Application	Market Size (USD Million)/Market Share (%), 2015	Market Size (USD Million)/Market Share (%), 2022	CAGR (2016-2022)
Indoor Lighting: Residential			
Indoor Lighting: Commercial			
Indoor Lighting: Industrial (Factories/Warehouses)			
Indoor Lighting: Others (Government and Public Buildings)			
Outdoor Lighting: Highway and Roadway			
Outdoor Lighting: Architectural			
Outdoor Lighting: Public Places			
Outdoor Lighting: Others (Rail lines and Harbors)			
Total	100%	100%	

Primary's Viewpoint: _____

Q. 6. Can you enlist the Top 5 players in the LED lighting market and their respective market share?

Sr. No.	Company	Market Share in 2015 (%)
1		
2		
3		
4		
5		

Primary's Viewpoint: _____

Q. 7. What are the drivers, restraints, opportunities, and challenges for the global LED lighting market?

Drivers	Restraints	Opportunities	Challenges

Primary's Viewpoint: _____

Q. 8. What are the technologies/product areas that will have a significant impact on the market in the future?

Primary's Viewpoint: _____

Q. 9. What will be the revenue pockets for the market in the next seven years?

Primary's Viewpoint: _____

13.3 KNOWLEDGE STORE: MARKETSANDMARKETS' SUBSCRIPTION PORTAL

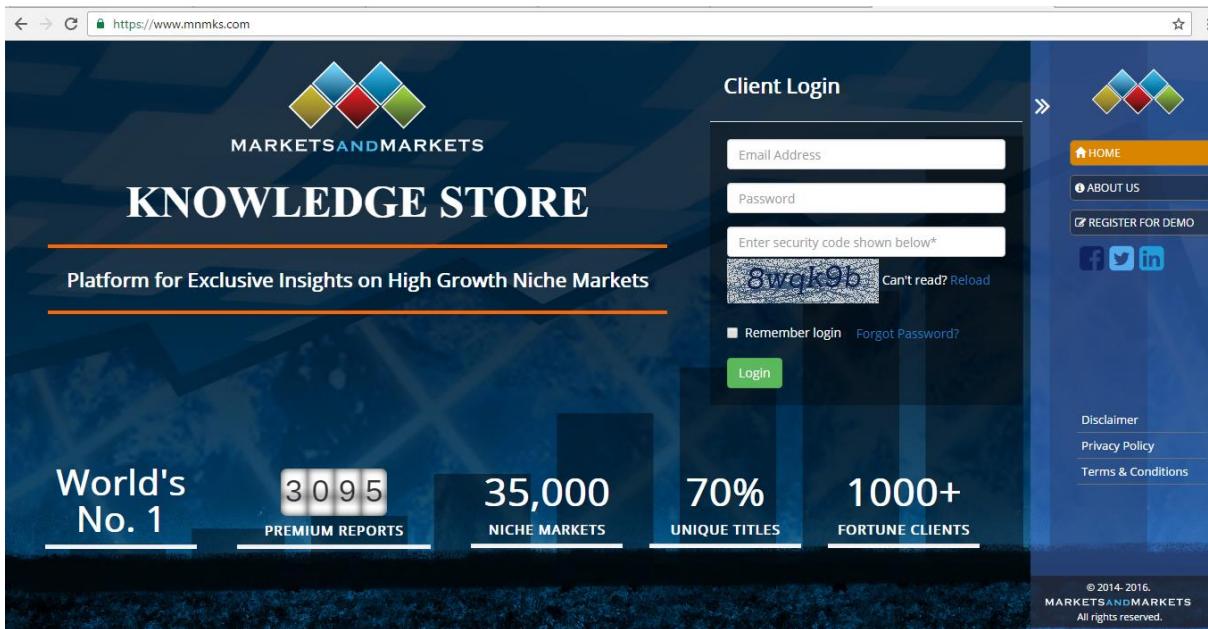
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MARKETSANDMARKETS KNOWLEDGE STORE: SEMICONDUCTOR & ELECTRONICS INDUSTRY SNAPSHOT

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SORT BY: CAGR ▾

Reset Selection

- Chemicals & Material (610)
- Healthcare (598)
- Semiconductor & Electronics (527)**
 - Electronics System & Components (76)
 - Sensors and Control (59)
 - Security & Surveillance (55)
 - Semiconductor Materials & Components (55)
 - Display Technology (50)
 - Industrial Automation (38)
 - LED & Lighting (Optoelectronics) (37)
 - Electrical System & Components (36)
 - Communication & Connectivity Technology (34)
 - Internet of Things & M2M (22)
 - Drones & Robotics (21)
 - Testing, Inspection & Certification (18)
 - Information System & Analytics (12)
 - Battery & Wireless Charging (10)
 - Information & Communications Technology (438)
 - Energy & Power (255)
 - Food & Beverage (190)
 - Aerospace & Defence (130)
 - Agriculture (127)
 - Automotive & Transportation (118)

CAGR* (%)

Industry	CAGR*
Battery & Wireless Charging	31.38
Display Technology	31.33
Communication & Connectivity...	24.9
Information System & Analytics...	22.62
Semiconductor Materials...	19.98
Security & Surveillance	18.33
Drones & Robotics	17.88
Internet of Things & M2M	17.8
LED & Lighting (Optoelectronics)	15.56
Electronics System & Components	15.15
Sensors and Control	13.55
Electrical System & Components	10.53
Testing, Inspection & Certification	8.26
Industrial Automation	8.26

*CAGR (Compound Annual Growth Rate) represents Market Value (USD) growth forecast for a period of 5 years. It is an average CAGR based on the high growth niche markets covered in MarketsandMarkets syndicated reports and should not be interpreted as Industry CAGR.

Source: MarketsandMarkets Reports published since Jan 2015

Semiconductor & Electronics

CAGR %

Electronics System & Components

Magnetic Refrigeration Market by Product (Refrigeration, Air conditioning, Heat pumps), Application (Domestic, Commercial, Transportation & Industrial) & Geography - Global forecast to 2020 98.7 Aug, 2015  

Hardware Encryption Market - By Algorithms (AES, RSA), Architectures (FPGA, ASIC), Products (Hard Disk Drives, USB Drives and In-Line Encryptors), Applications, Verticals and Geography - Analysis & Forecast (2013 – 2018) 62.17 Jul, 2013  

Hybrid Memory Cube and High-Bandwidth Memory Market by Density (2GB, 4GB and 8GB), Application (Enterprise Storage, Consumer Electronics (PCS, Gaming Consoles and Laptops) and Networking and Telecommunication), & Geography - Global Forecast to 2022 53.96 Apr, 2016  

Sensors and Control

Wearable Sensor Market by Type (Motion, Pressure, Temperature, Medical & Others), Application (Wristwear, Eyewear, Footwear, Bodywear), Industry Verticals (Consumer, Healthcare, Enterprise) and Geography - Global Forecast to 2020 47.7 Oct, 2014  

IoT Sensors Market by Type (Pressure, Temperature, Humidity, Magnetometer, Accelerometer, Gyroscope, Inertial, Image), Network Technology (Wired & Wireless), Vertical (Consumer IoT, Commercial IoT, Industrial IoT), and Region - Global Forecast to 2022 42.08 Aug, 2016  

Asia Pacific Acoustic Wave Sensor Market by Sensing Parameter (Temperature, Pressure, Mass, Torque, Humidity & Others), by Application (Automotive, Military & Aerospace, Consumer Electronics, Healthcare & Industry), by Geography - Analysis & Forecast to 2019 32.8 May, 2015  

Security & Surveillance

Gesture Recognition For Smart TV Market by Software (2D & 3D Image Sensor), Hardware(Image Sensor, IR Proximity Sensor, IR Temperature Sensor, Light Sensors, & Semiconductor ICS), And Geography (Americas, EMEA, & APAC) - Analysis & Forecast to 2013 - 2018 131.26 Mar, 2014  

Asia-Pacific Gesture Recognition & Touchless Sensing Market (2013 - 2018): Technology (2D, 3D, Ultrasonic, IR, Capacitive); Product (Biometric, Sanitary); Application (Healthcare, Electronics, Automotive); Country (India, China, Japan, South Korea) 42.33 Apr, 2013  

DIY Home Automation Market by Offerings (Hardware and Managed Services), by Technology, and by Geography (The Americas, Europe, APAC, and RoW) - Global Forecast to 2020 37.9 Nov, 2015  

Ask Analyst

Request for Consulting

Suggest Title

13.4 INTRODUCING RT: REAL-TIME MARKET INTELLIGENCE

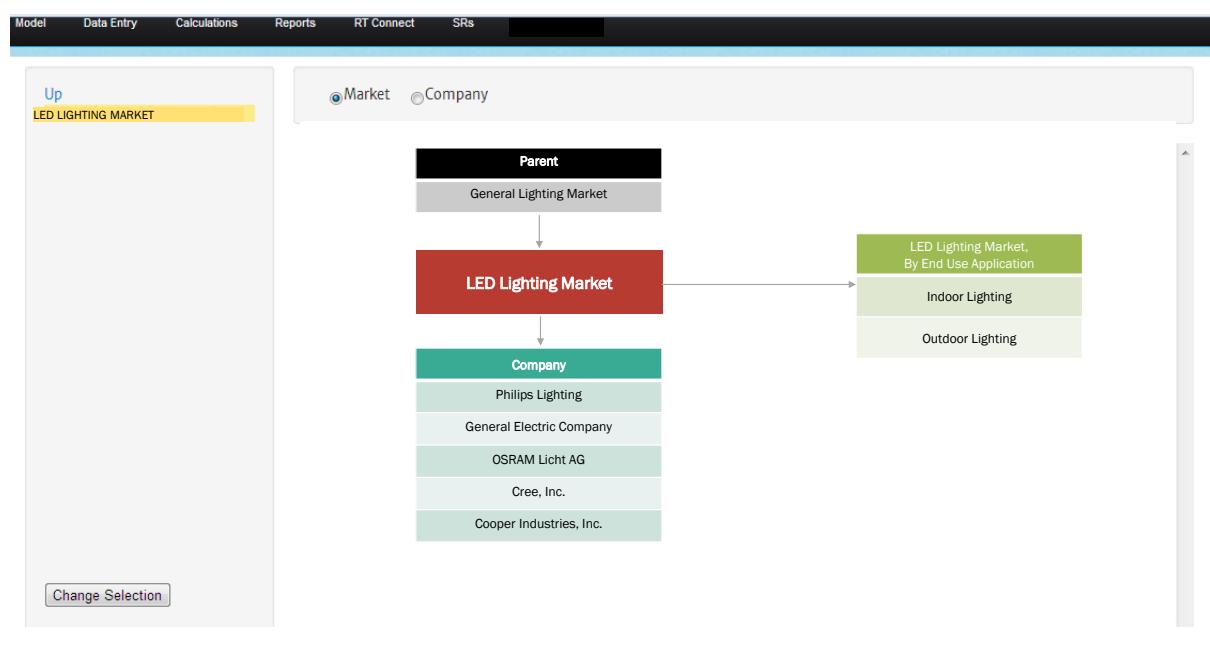
Revenue Tree (RT) is an interactive platform that systematically helps the user to enhance revenue by identifying the high-potential growth markets and tracking the same on a real-time basis on a competitive, customer-centric, and ecosystem level.

The in-built intelligence of the tool auto-identifies the competitors, allied markets, market value, and customers, and helps the user identify tangible hotspots of revenue growth both in the existing and new markets. The unique feature of RT is the Ecosystem which is linked across a wide range of industries and markets.

Features and Benefits of RT:

- Visual presentation of the market data
- Real-time information on market trends and developments
- Information specific to installation type, end-use application, product type, and geography
- Competitive intelligence (by tracking developments of major players)
- Forward integration in the value chain to find potential clients
- Comparison of two or more markets

Value Chain



Market Dashboard



13.5 AVAILABLE CUSTOMIZATIONS

With the given market data, MarketsandMarkets offers customizations according to the company's specific needs. The following customization options are available for the report:

Company Information

- Detailed analysis and profiling of additional market players (up to five)

13.6 RELATED REPORTS

Sr. No.	Report Title	Publication Date
1	SMART LIGHTING MARKET Smart Lighting Market, by Product Type (Smart Bulbs, Fixtures, and Lighting Controls), Light Source (Fluorescent, LED, HID), Communication Technology (Wired and Wireless), Software & Service, Application, and Geography - Global Forecast to 2022 http://www.marketsandmarkets.com/Market-Reports/smart-lighting-market-985.html	September 2016
2	LED DRIVER MARKET FOR LIGHTING LED Driver Market for Lighting, by Driving Method (Constant Current and Constant Voltage), Luminaire Type (A-Type, T-Lamps, Reflectors, Integral Modules), Component (Driver IC and Discrete), End User Application, and Geography - Global Forecast to 2022 http://www.marketsandmarkets.com/Market-Reports/led-driver-ic-390.html	April 2016

13.7 AUTHOR DETAILS

Jagdish Rebello

Global Vice President - Semiconductors and Electronics

Dr. Jagdish Rebello brings more than 25 years of experience in creating long term growth strategies, driving profitable revenue growth and managing product lines and business units for technology, business intelligence, consulting and manufacturing companies.

Prior to joining Markets and Markets, Dr. Rebello was a Senior Director at IHS where he successfully led and managed the Semiconductor Market Research and Competitive Landscape product portfolios. A strategic thinker and patent holder with an outstanding track record of success, Dr. Rebello also successfully managed the Wireless Communications, Connected Consumer Electronics and Cloud Services portfolios during his tenure at IHS. He has worked with C-Level executives and Business Unit VPs to create detailed use cases, business models and revenue streams associated with data analytics and the transformation of data into information in the connected car, smart home and industrial automation applications.

Jagdish Rebello has also successfully served as the product manager for photonic components at ADC Telecommunications and for Optical Spectroscopy Instrumentation at Horiba Scientific.

Sachin Garg

Senior Research Manager

Sachin is a Management & Engineering professional with more than 11 years of experience in Electronics & Semiconductor business of different applications like Consumer Electronics, Automotive, Healthcare, Industrial etc. He has worked with the leading IT & Semiconductor companies like STMicroelectronics Pvt Ltd, NXP Semiconductor Pvt Ltd & Cognizant Technology Solutions. He has worked in projects related to System on Chip, Smart Things, Internet of Things, Augmented and Virtual Reality, Wireless Power, Power Management ICs, Product Miniaturization Technologies Nodes for Industry Analysis, Market Sizing, Go-to-market strategy, Growth strategy, Business planning and strategic analysis.

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Ashish Mishra: Assistant Manager

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