

Lighting Industry

The Bright Future of LED & LiFi

In this report, we analyze the history of the lighting market, from the commercialization of the incandescent light bulb to the evolution of LED lighting. We discuss the many reasons for the growing shift away from more conventional types of lighting, like fluorescent, halogen, and incandescent, to LED lighting that is more efficient with longer lifetimes. We discuss how value is shifting in the industry away from commoditized lamps, and towards fixtures and connected lighting with the increased penetration of LED.

One of the very important key trends in the lighting industry is the advent of LiFi, with big impacts in the healthcare and retail sectors. LiFi can help accommodate the growth in our data needs with speed and flexibility as the population grows and the world continues to evolve.

Finally, in our report we discuss the impact of supply chain shortages and the construction market on the lighting industry. We also offer a brief case study on PureLifi and Signify.

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Sector Overview

Sector History

When most of us think of the light bulb, we often think about Thomas Edison, the American inventor who helped to commercialize the incandescent light bulb. Since that time so long ago in 1879, the light bulb has come a long way. Now, we have so many different types of light bulbs to choose from, whereas earlier generations only had a few different types of the more traditional lighting technology to choose from.

Following the very inefficient incandescent bulb, the fluorescent, high-intensity discharge (HIDs), halogen, and CFL bulbs were invented, to form what we call “conventional” lighting. Fluorescent lighting was commercialized in the 1930s and 40s and was typically used in large commercial buildings. High intensity discharge lights (HIDs) were commercialized in the 1990s and were commonly used in vehicle headlights and commercial outdoor lighting such as stadiums and parking lots.

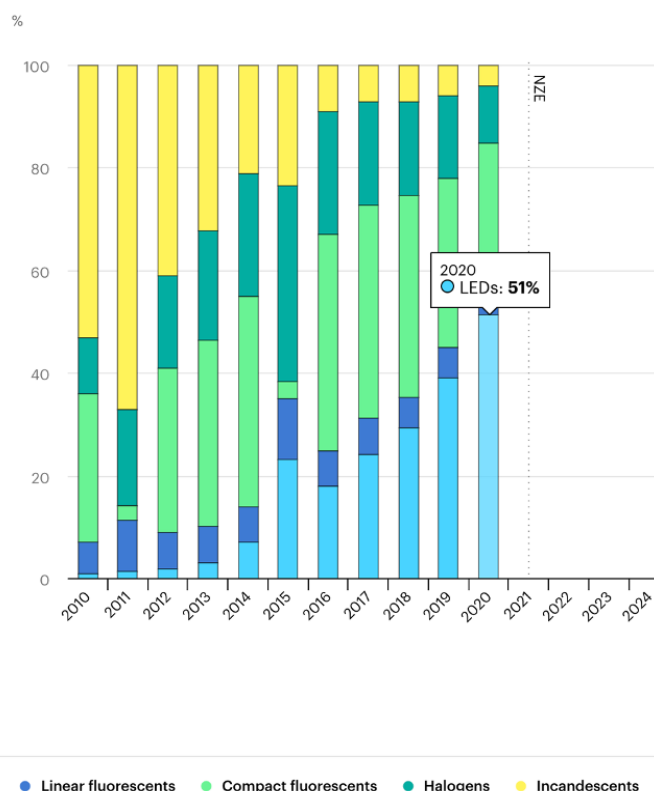
Conventional lighting is very energy inefficient and has short lifetimes, so it’s obvious why its obsolescence is impending. In the 1960s the LED light bulb was invented and improved upon over the next 60 years. Fast forward to today and the LED light bulb has an average lifespan of 15-20 years, is more efficient, and has a lower total cost of ownership compared to conventional light bulbs. From its entrance in 1960, the LED bulb has evolved to become practical and economical in many applications, and has resulted in it being the “go-to” light bulb in many instances. Specifically, architectural lighting has been one of the earliest adopters of LED lighting.

LED Share

There are three major sectors in lighting: general lighting, automotive, and back-lighting. General lighting is the largest, representing about 75% of the total lighting market, and is classified into 7 different applications: residential, office, shop, hospitality, outdoor, and architectural lighting.

Many countries worldwide have banned the sale of particularly inefficient types of conventional lighting, in favour of LED’s. Over the past several years, LED prices have significantly eroded, owing to technological innovation and competition, notably coming from Chinese competitors, who entered the American market selling lower-quality, but cheaper bulbs. This has helped contribute to the increased penetration of LED bulbs.

Shown in the graph, LED penetration worldwide has increased from 3% in 2013 to 51% in 2020, at the expense of inefficient conventional bulbs.



Sources:

International Energy Agency, McKinsey Perspectives on the Global Lighting Market, Lumenistics – a look at the history, present, and future of the lighting market

Sector Overview

Unit Economics

Over the past several years, LED prices have significantly eroded, owing to technological innovation and intense competition, notably coming from Chinese competitors, who entered the American market selling lower-quality, but cheaper bulbs. This has helped contribute to the increased penetration of LED bulbs.

The price erosion and longer lifetimes of LED bulbs has caused concern over the replacement cycle and volumes. The impact of falling volumes can be tempered by the adoption of higher-priced LED luminaires and smart lighting. Additionally, despite the lower profitability of LED bulbs, LED luminaires (where the light bulb is integrated into the fixture) and smart lighting, are higher-margin, less commoditized, and will benefit players with the strongest brand.

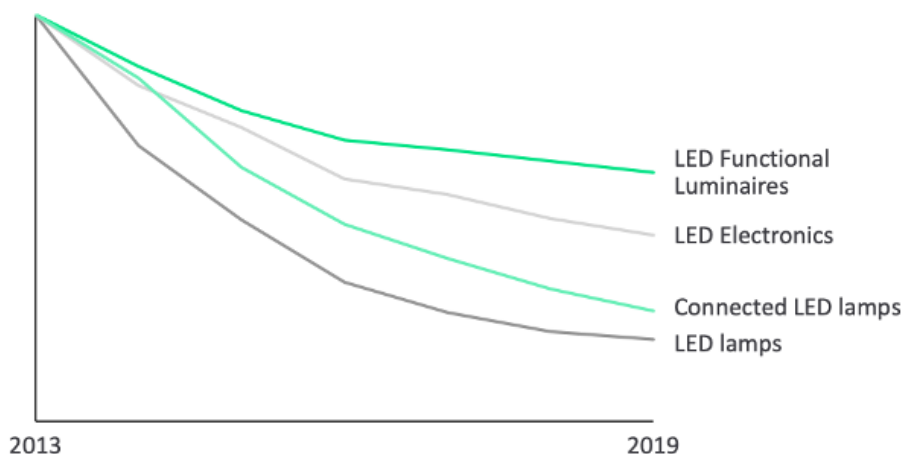
Historically, the lighting market growth has tracked global GDP growth at about 3%. The market for luminaires and lighting systems is driven by new installations, which are linked to construction activity – a clear link to GDP.

Shifting Value

The installation business is benefitting from LED penetration since new installations are following renovation cycles rather than the lifetime of the technology. The higher initial price point of LED is also benefitting the installation market. With the longer lifetimes of LED, replacement will be driven by renovation cycles, rather than LED lifetimes. For instance, the average renovation cycle in retail is approximately eight years, while the lifetime of LED is well above that.

Due to these factors, the market is shifting value from lamps to fixtures and connected lighting systems. With the emergence of connected lighting systems, i.e. smart lighting, quality and technological know-how, particularly in the professional market, is becoming a more important point of differentiation among players. This is in deep contrast to the commoditization of the lamp market. Additionally, “lighting-as-a-service” and lighting maintenance services are being explored with the longer lifetimes of LED’s.

Average unit selling price
indexed at 2013 value



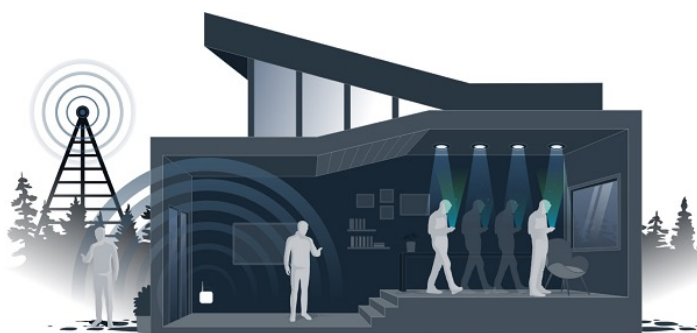
Sources: Signify Capital Markets Day, McKinsey Perspectives on the Global Lighting Market



Key Trends

An Explosion in LiFi Systems is Coming

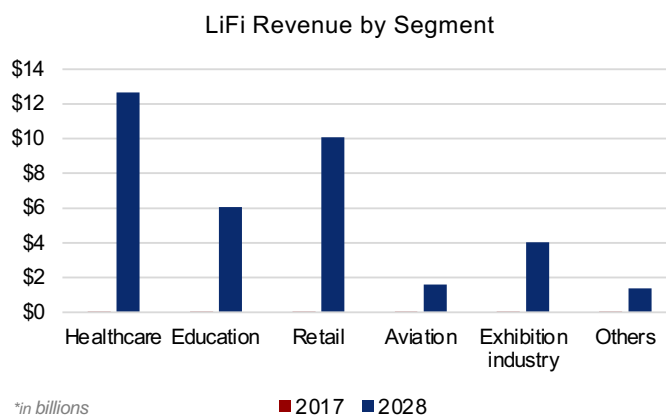
LiFi is a wireless data transmission technology like WiFi, however instead of using radio waves to transmit data, LiFi uses light waves. The basic idea is that LiFi-enabled LED lights modulate illumination levels very fast (faster than the human eye can perceive) in order to transfer data to receivers. LiFi allows for bi-directional data transmission and can achieve very high-speed data transmission - upwards of one gigabit per second. This is an innovative solution to what is known as the spectrum crunch caused by an over saturation of radio frequencies being used by traditional wireless transmission systems. As the world consumes more and more data every year, LiFi hopes to provide the speed and flexibility to accommodate the growth in our needs as we move forward.



The left router depicts traditional WiFi, and the right illustration depicts LiFi.

Ever since LiFi was introduced in 2011 by Prof. Harald Haas, the technology has slowly been gaining momentum. The technology is especially exciting because a large part of the data transmission that we conduct happens indoors, where light always surrounds us. Much of the infrastructure that will be required to implement LiFi already exists, as Haas explains in his TedTalk. Moreover, LiFi also offers increased security as light cannot pass through walls, and as the visible light spectrum is 10,000 times larger than the radio wave spectrum, offers a solution to the capacity constraint problem that we are moving towards with the use of traditional wireless transmission technology. While LiFi will likely not completely replace previous data transmission mechanisms, the increase of its importance is imminent and palpable, as can be seen in the enormous growth forecasted on the right.

Projected Growth in the LiFi Market



There is no error in the graph above. That is the astonishing growth in the size of the LiFi market that is projected over the next couple of years by Statista. The largest growth is in the healthcare segment, where the LiFi market will grow from \$28.4 million to over \$12 billion in just over a decade. According to Research And Markets as of June 2021, the LiFi market which stood at about \$400 million in 2020, will grow to \$15 billion by 2027, a compounded annual growth rate of 68%. It is evident that the market for LiFi will see tremendous growth in the future. It is possible that this growth may be affected by the ongoing chip shortage, or other hindrances that are currently plaguing global supply chains. Regardless, the technology has tremendous potential and will see growth in the coming years.

Currently, the largest market for LiFi is North America where 35.9% of the market is concentrated. Reasons for this include an increasing need for energy efficient devices, growing demand for high-speed bandwidth, and an excellent eco-system enabling modern technology to be introduced easily.

Some of the largest players in the LiFi market currently include PureLiFi, Panasonic, Oledcomm, Fsona, and VLNComm. With the size of the market expected to grow at the rate that it is, investments in LiFi has the opportunity to see great returns in the future.

Sources: pureLiFi, TedTalks, Statista, Research And Markets, and Emergen Research



Key Trends

LED Growth Supports LiFi Predictions

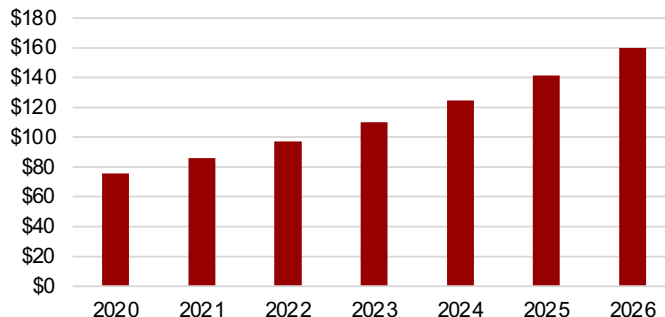
LiFi is heavily dependent on the use of LED technology, given that those are the only kinds of light that can modulate at the rate necessary for LiFi to work. While it is not the only component of such a system, it helps that LEDs have been used more and more over the last decade. Not only this, the price of LEDs has also dropped significantly in the last few years. In 2011, the average 60-Watt equivalent LED products has dropped from \$40-\$50 to below \$10 by 2018, with some of the lowest priced products going as low as \$2.

There are several factors that have allowed for this extensive growth in the popularity of LED technology. One of the primary reasons is their energy efficiency. They use 90% less energy than incandescent or halogen bulbs. Not only does this help save costs for consumers, but it has a significant impact on the climate as light bulbs are installed in all indoor spaces around the world. Given this, regions such as the European Union, Switzerland, Australia, Brazil, and others began phasing out incandescent and halogen lights as early as 2005. Additionally, LEDs have a much longer lifespan than other ways of lighting. They have an average lifespan of 50,000 hours compared to 1,000 hours for incandescent bulbs. What also adds to their attractiveness is the fact that they are available in many different colors, designs and even product format from bulbs to strips. All these reasons have led to the increasing usage of LED technology and the phasing out others.

As reported by the U.S. Department of Energy in 2020, the largest exporter of LED Luminaries and LED lamps is China. China exported \$15.52 billion of LED luminaires and \$5.32 billion of LED Lamps in 2019. The biggest importers of these LED products is Europe and the United States. They imported \$1.87 billion and \$1.62 billion of LED lamps respectively, and \$4.94 billion and \$4.77 billion of LED luminaires, respectively.

The Future Looks Bright

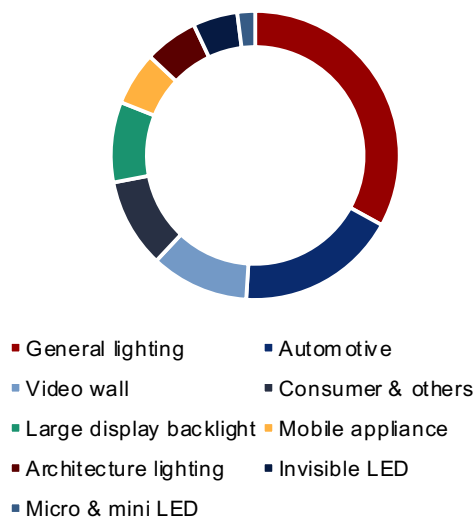
*in billions Global Market for LED Lighting (2020-26)



The size of the global market in 2020 was \$75.5 billion and is projected to grow up to \$160 billion by 2026, with a CAGR of 13%. The evolving pandemic situation and global supply chain hindrances may play a role in slowing down the extent to which this level of growth can be achieved. However, given the supremacy of LED over other lighting technologies, this trend will continue.

As can be seen in the graph below, as of 2021 the largest source of revenue for the LED industry is general lighting, followed by automotive, and then video wall.

LED Market Share 2021



Sources: The Guardian, 99 acres, Statista, U.S Dept. of Energy

Case Study

Key Players



- Signify is the biggest manufacturer and seller of lighting products globally. They were formed in 2016 as the result of a spin-off of Philips lighting division.



- Acuity Brands is the largest LED provider in the United States. They're also involved in the building management side of lighting. This involves lighting controls and connected lighting systems for commercial spaces.



- PureLiFi was co-founded by Mostafa Afgani who is a pioneer in the field of LiFi and has led the engineering & development of pureLiFi's systems and solutions.

The First Mover Benefit

Since the company's inception in 2012, they've been a leader in "LiFi" innovation. Afgani, who leads the engineering and development, created the first ever commercial LiFi product (Li-1st) the first mobile LiFi product (Li-Flame), and the first high-speed LiFi dongle (LiFi-X). Prior to co-founding PureLiFi, Afgani worked on sensitive signal anomaly detection systems for Agilent Technologies and held a research position at DoCoMo labs. Alistair Banham, the CEO of PureLiFi, is a global semiconductor industry veteran with more than 30 years of experience in the field. Alistair is an expert in driving increased adoption for tech-related products. The company raised over \$73 million across 13 funding rounds. In December, the company announced a partnership with the U.S. military to develop defence-based LiFi products. LiFi not only enhances the U.S. Army's wireless connectivity toolset, but has demonstrated in action, that LiFi solves real problems faced by defence and national security. With the boom in demand for LiFi products and PureLiFi's industry leading innovation, they are well positioned to capitalize on the upside.

Making the case for Signify

Signify was originally called Philips Lighting N.V when it was spun off from Philips. The name change occurred in 2018. Despite the spin off, the company still produces lights under the Philips brand. Signify's product offerings consist of electric lights, the IoT (internet of things) platform, and connected lighting systems aimed at consumers and professionals.

They recently made the acquisition of Telensa to bolster their smart city offerings. This acquisition helps them position themselves to capture the smart city upside. They've also spent a significant amount of money developing smart home lighting products in recent years.

In recent quarters, the company has faced supply chain issues that haven't allowed them to meet customer demand. In Q2 2021, they had the highest number of missing e-components. They've also been faced with an increasing cost of inputs which has put serious pressure on margins. These headwinds have caused them to be conservative on guidance but there is still a positive outlook for the future.

Financials Metrics	
Market Cap	€5,788.43
P/E	10.65x
EV/EBITDA	6.18x
5-Year Revenue CAGR	-0.3%
Gross Margins	39.4%
ROE	16.5%
ROIC	14.5%



Case Study

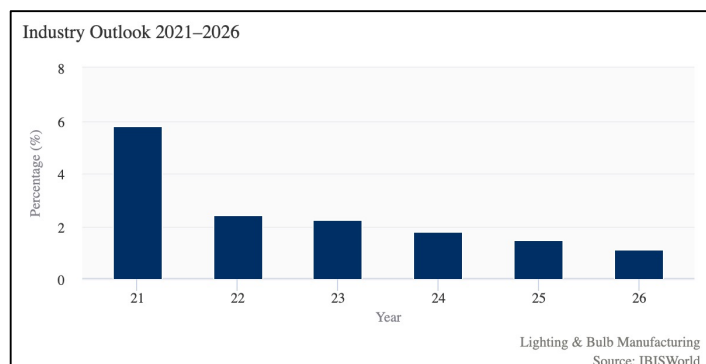
Supply Chains Leaving Sellers in the Dark

Supply chain issues have been the main story of the lighting industry in the last 2 years. The global electrical components shortage has created numerous challenges for the entire industry. As we saw with Signify, a shortage of semiconductors, plastics, resins and metals have left companies in tricky situations. Not only is there a shortage of components, but also a shortage of containers in China to transport the components.

These shortages have led to a rise in input costs. Many lighting manufacturers have announced price hikes throughout 2021. For example, in 2020 the price for a pound of copper was \$2.33. In 2021 this figure rose to \$4.74.

Construction Spending Fuels Bright Future

In recent news, the bipartisan infrastructure bill should prove beneficial to the lighting industry. The 1.2 trillion-dollar plan doesn't mention anything specifically about lighting but the investment in construction of commercial buildings will need to have lighting.



Despite this industry being considered mature, it will have a boost in revenue from commercial construction. Lighting will also benefit from the horticulture industry, which is heavily reliant on lighting devices. It's expected to reach \$1.78 billion in 2025, a 20% growth from today's amount. Recently, Signify acquired Fluence, a company that builds lighting devices specifically made for the horticulture industry. Signify's CEO, Eric Rondolat, expects this acquisition to help them gain serious market share in the horticulture lighting industry. One of the reasons for the horticulture industry growth is the legalization of cannabis. Fluence, which is American based, is well positioned to capitalize on the upside.

Overall, the lighting industry has faced many headwinds in recent years caused by the global pandemic. Going forward there are many reasons to be excited about the industry. The explosion in LiFi systems will see companies spend large amounts on R&D to gain vital market share. Furthermore, the demand for more efficient LED lighting systems should prove beneficial for the industry. As global supply chain issues are resolved and construction demand increases, companies will be able to thrive.



These issues will continue to create headwinds for the industry in 2022 and potentially beyond. However, with the Commercial Construction Index continuing to rise since it bottomed out in March 2020, the demand for lighting should be plenty sufficient.