Guidehouse INSIGHTS

**White Paper**

# Connected Lighting and Light as a Service in Manufacturing

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**Commissioned by**

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# Introduction

Light as a Service (LaaS) is a flexible, performance-based lighting management service that can include connected lighting systems and intelligent controls to optimize usage. Beyond purchase and installation, business models for LaaS incorporate additional maintenance, technical, operational, and financial services. Connected lighting is increasingly being complemented by the installment of upgraded, more efficient lighting fixtures. As energy efficient LEDs continue to have strong market penetration and interest in connected lighting systems grows, LaaS has the potential to promote increased congruent adoption of these technologies. LaaS with additional software capabilities can connect intelligent controls and connected lighting systems to adapt lighting and extract valuable data from each fixture and the lighting installation as a whole. LaaS can range from fulfilling lighting upgrades to installations that include advanced sensors, controls, and network communications to add value to an organization's core mission. Lighting data and software can also be integrated with alternative building control systems and platforms through open APIs, cloud connectivity, or BACnet access, depending on customer needs.

A key challenge of the as a service business model for manufacturing customers is shifting business spending from CAPEX to OPEX. When a manufacturer makes purchases from a CAPEX budget, the expense of the purchases rarely passes to their customer or affects price points. However, unanticipated upgrades and maintenance are more difficult to resource and manage. Replacing assets with services that are routinely budgeted from OPEX lowers the total cost of ownership, making the expense and additional cost savings a cash generating process rather than a resource constraining investment. The business model for LaaS requires spending patterns to shift to allow for the adoption of subscription-based expenditures and third party owned and operated assets. In return, LaaS customers avoid upfront capital costs and reap savings benefits. Hardware installations for connected lighting and LaaS are incorporated into the duration of the contract. Therefore, upfront investments for hardware installations are divided up over the subscription period, eliminating the amount of required expense to replace or install connected lighting systems.

LaaS service contracts have more flexibility than average procurement contracts. When investing in connected lighting and LaaS, customers can build safety and efficiency expectations and requirements into contracts with providers to achieve specific outcomes. Impacts to balance sheets and business outcomes are enhanced when coupling lighting systems and intelligent controls. These can be installed by the same vendor or integrated with other building management systems. However, using the same vendor empowers customers to stipulate additional key performance indicators (KPIs) in a single contract and investment based on both the lighting systems and the controls. If the controls are sourced from elsewhere, the lighting system vendor has no control over their performance.

Manufacturers often have to make long-term operational and financial decisions about several assets that they own, operate, and maintain. As mentioned previously, LaaS offers customers the opportunity to require that certain KPIs are met over the duration of the contract. For example, a customer can request an energy performance contract where energy savings must exceed a certain percentage annually and require the LaaS provider to share aggregate lighting data as evidence of increased efficiencies and associated cost savings. Additional KPIs can be measured and evaluated throughout the customer/provider relationship and contract period. Lastly, installations can be tested in one area of operations and scaled up after proof of concept phases as KPIs are met and evaluated. The desire to reduce operational responsibilities and yield additional value from assets has led to manufacturing being identified as a prime candidate for LaaS offerings where KPIs can be predetermined and delivered. In this white paper, Guidehouse Insights evaluates the market cornerstones, benefits, and challenges for connected lighting and LaaS, offering recommendations for manufacturers looking to enhance and upgrade lighting systems.

# The Market

LaaS offers competitive pricing while outsourcing the installation, management, and maintenance of large industrial lighting systems. For manufacturers, LaaS can enhance substantial building renovations by reducing energy costs and consumption and transferring lighting maintenance and management to a third-party provider. On average, energy savings generated by the fifth year of an LaaS contract exceed the total costs of LaaS over the same period. Over a longer contract period, further savings generated by LaaS can be allocated elsewhere in the business. These longer contract periods for LaaS reduce the recurring service and subscription fees, increasing initial and year-over-year savings. Lighting can be made operational before the installment is paid off. The benefits of this business model include immediate savings, upgraded working environments, and advanced lighting metrics for risk management, safety, and sustainability. Outsourcing lighting management also creates savings by reducing employees' time spent on lighting management and maintenance and by enabling remote operations, reducing travel to and time spent on the premises.

Big data is creating additional value for as a service business models, introducing data monitoring and management in manufacturing environments to integrate all areas of an operation. A key driver for LaaS is the proliferation of programmable sensors for data collection in industrial environments. Life cycle maintenance has historically been centered on replacing lamps and ballasts, cleaning luminaires, and ensuring that there are no faulty components within the lighting system. With LaaS, life cycle maintenance is greatly reduced compared with legacy lighting systems through creating resources for maintenance of sensors and other system components. The adoption of building codes such as the WELL building standard; new data standards for collection, security, and privacy; and the proliferation of remote services are accelerating these trends.

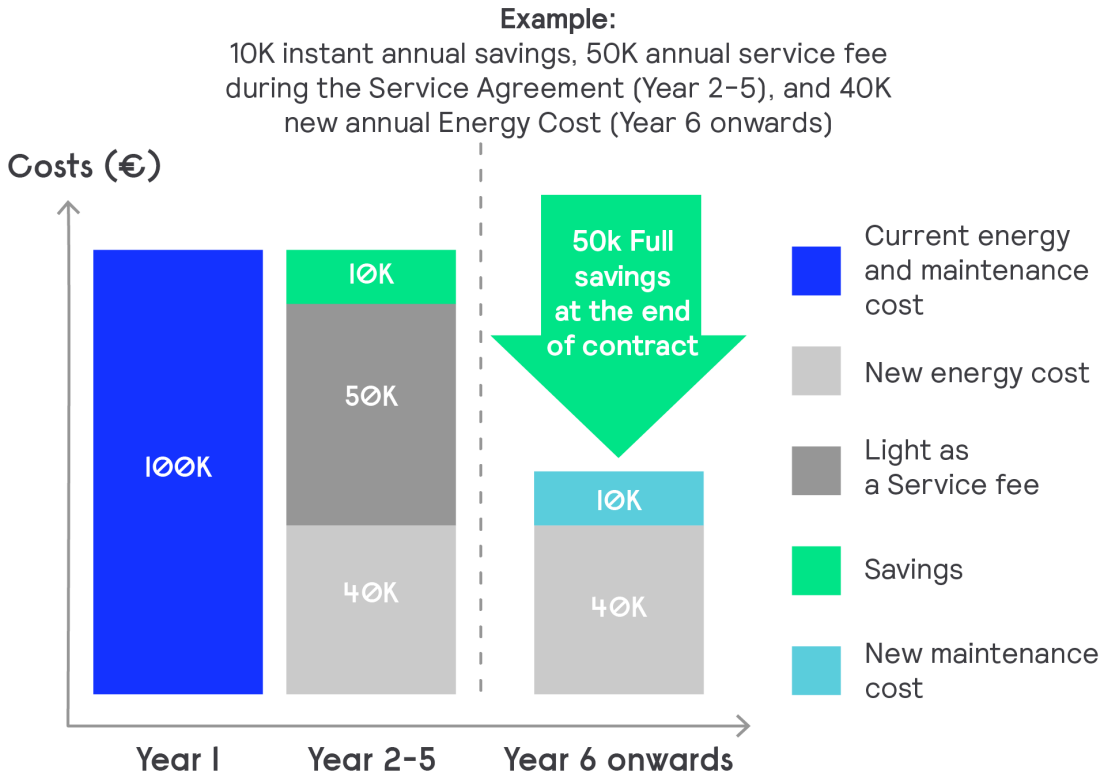
The limited mobility and economic impacts of the global COVID-19 pandemic have created delays in new product development and distribution across manufacturing from the aerospace and automotive sectors to food, pharmaceuticals, rail, and transportation. The pandemic has also illuminated the benefits of shedding the burdens of capital assets in favor of cash flow. Downtime and cash flow are new incentives to pursue renovations and adopt as a service business models with cost savings in mind before ramping up new production. LaaS investments can be financed with the very cash flow that they produce in savings and remove liability associated with directly owning and operating lighting assets. Manufacturers that possess inefficient or outdated lighting fixtures requiring significant maintenance or are looking at upgrade options should weigh the costs and benefits of deploying LaaS in their environments.

## Financial Challenges and Operational Pain Points

The shift from CAPEX to OPEX can be a major pain point for manufacturers, often requiring changes in business and operational thinking. By shifting from a traditional systems procurement mindset to a service perspective, LaaS provides financial advantages to manufacturers beyond moving investment from CAPEX to OPEX. End users receive the products and services that they want and need without buying and maintaining assets. The LaaS provider owns the physical lighting infrastructure, leaving the end user free to enjoy the energy and maintenance savings. LaaS offers a predictable ongoing payment schedule that is often easier to budget for than a massive upfront investment while lowering the monthly/annual subscription fees for longer contracts. In terms of the ROI, the costs of LaaS and its energy consumption are typically less than the energy and maintenance costs of the legacy system in place. Lastly, contract durations can be implemented based on energy usage and lifetime of the lighting system, resulting in contracts that encourage immediate cost savings to produce cash flow.

For example, a 10-year contract with hardware installation costs distributed over the length of the contract provides an affordable annual subscription while increasing annual energy savings and ROI. Maintenance requirements and upgrades are built into contract agreements, shifting reliability and responsibility to the lighting system supplier. Cost and energy savings are realized in year 1, while the full installation fees may not be paid in full until years later based on annual costs and contract duration. This financing flexibility alleviates large upfront investments to generate immediate savings. Therefore, year 1 investments in LaaS can drastically improve the balance sheet for year 2, as shown in Figure 1.

***Figure 1 LaaS Energy Savings and ROI Potential***




*(Source: Signify)*

## Reduced Energy Consumption

Managers of plants, warehouses, and factories used for manufacturing goods around the globe often lose energy from outdated commercial lighting fixtures, knowingly or unknowingly. While legacy investments are meant to endure long life cycles, unnecessary consumption leads to high levels of energy waste that render lighting systems inefficient. However, installation of a connected lighting system is more likely to follow the replacement life cycle. It is generally more common for buildings to retrofit lighting systems when there is a viable business case (i.e., tax or government incentives) or after experiencing a failure from the existing lighting system. Combining connected lighting controls with a lighting retrofit—to LEDs for example—creates a more valuable and viable business case for investment. LaaS can also incorporate sustained ROI metrics and annual energy benchmarks from the provider into contracts.

Upgrading to LaaS can accelerate any long-term renovation plan. While maintaining budgets seems incongruent with the decision to rip and replace fixtures, connected lighting can reduce lighting energy consumption by at least 50% and optimize the utility of lighting systems to add value to business planning and operations. Depending on the severity of energy waste per location and the age of the current lighting system, adding intelligent controls to connected lighting can increase savings up to 90%. Smart controls can maximize savings by using a smart lighting platform to dim luminaires in response to bright noontime light or in unoccupied areas of an office. In addition, retro commissioning a component for system optimization can provide increased energy savings. System optimization includes mechanisms that ensure the lighting system is operating as planned and provides the ability to adjust light timing or light level based on collected data. The continuous gathering and analysis of data can be used to facilitate the system continually meeting the needs and schedules of occupants over time.

## Increased Safety and Sustainability

Upgrades to lighting with connected lighting and LaaS positively affect the health and safety of workers in manufacturing plants and warehouses. At the same time, these investments influence an organization's bottom line and provide data-driven metrics to bolster decision-making. Better lighting reduces the risk of accidents by illuminating machinery, walkways, workstations, and appropriate safety signage. LED lighting reduces the appearance of shadows, has little lumen depreciation, and can be adapted with lenses to create illuminating light beams, ensuring that employees and visitors can see and avoid potential hazards and collisions. In addition, some manufacturers may no longer have use for inefficient high intensity discharge lamps. LaaS can be structured to adhere to and enhance safety requirements in a given manufacturing environment and can be remotely adjusted to meet shifting priorities and complement uptime/downtime or scheduled maintenance.

LaaS functions as a simple and scalable solution for building managers who prioritize energy savings, sustainability, and regulatory compliance. In many parts of the world, manufacturing is considered critical infrastructure, including the production of primary metals, machinery, electrical equipment, and transportation equipment. Defense, commercial, retail, and travel industries are all dependent on aerospace, automotive, and transportation manufacturing to a degree. Also, the production of food and pharmaceutical drugs sustains social health and well-being. LaaS is seen as a life cycle investment to improve and upgrade critical infrastructure that advances environmental, social, and governance (ESG) goals. LaaS helps to reduce carbon emissions by lessening the amount of energy used in a manufacturing setting, increasing sustainability and providing a record of evidence for reduced energy consumption. LaaS also lends itself to the advancement of a circular economy in a global effort to minimize waste and reuse goods and materials by adding value to products and installations. These factors can improve a manufacturer's image as an ESG leader and advance sustainability. ESG leadership can improve company ratings, promote brand recognition, and drive new investments.

# LaaS Market Adoption Barriers

A major hurdle for LaaS investment is the bureaucratic process associated with transferring CAPEX requirements to OPEX and passing on responsibility within an organization. This shift requires an understanding of the as a service business model, an operational mindset change, and buy-in from executives and stakeholders across the organization. Breaking new ground for LaaS in any manufacturing environment will likely require adjusting change management goals and deliverables, affecting teams across departments. These departments can include (but are not limited to) finance, legal, and IT. Facilities managers typically assume responsibility for charting the course of an LaaS project and keeping it on track. While those in charge of purchasing may prefer shorter-term investment contracts or subscriptions, LaaS offers a more beneficial long-term ROI over solutions with shorter contracts that need continuous approval and resourcing. Short-term purchasing detracts from long-term durable solutions and relationships. In contrast, long-term services promote the creation and development of longer-lasting materials, user-friendly products and services, and trusted business relationships between customers and providers.

Awareness of potential energy and cost savings and education for new technology and software use cases are other key hurdles for LaaS deployments. Building owners and managers are not typically tasked with staffing requirements for complex control systems or IT operations. Intelligent controls for digitally connected systems require increasingly sophisticated software and may lead to a potential overlap of end users' operational roles and responsibilities. This overlap might lead to unique challenges for managing the transition to LaaS. Although outsourcing can offer a solution to human capital shortages stemming from an aging workforce, some companies may opt to invest in training to shore up digital skill sets for traditional roles in facilities management. A sustainability facility professional certification from the International Facility Management Association—which focuses on systems training for workplace and Internet of Things technology—is one option for building owners and managers who prefer to retain management of connected lighting and smart building solutions in house.

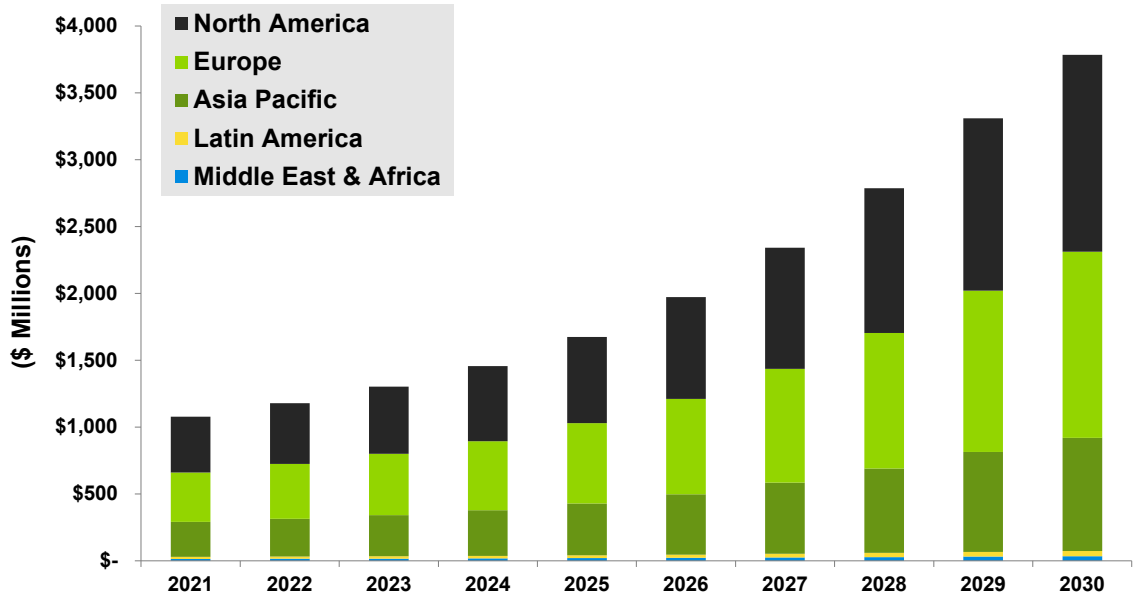
# LaaS Global Market Outlook

The as a service business model is used across various industries and is gaining popularity as new technologies emerge to add value with data and connectivity. This business model provides benefits in three ways by furnishing capital, providing continued maintenance, and ensuring a high performing system while allowing customers to outsource select areas of their business over time. Transferring the responsibilities to LaaS providers ensures that features and upgrades are kept up to date with market and technology developments. Increased adoption of smart, connected building devices and control systems coupled with the drive to meet sustainability goals will likely enable LaaS business models with beneficial contract terms and immediate recognition of cost and energy savings.

Guidehouse Insights estimates global LaaS revenue at $1.1 billion in 2021, growing to $3.8 billion by 2030 at a compound annual growth rate of 15.0%. The number of companies offering service business models is increasing to meet the changing lighting landscape within commercial buildings for expansion into more connected systems to propel the broader intelligent building market. Declining prices of LEDs help to drive the LaaS model, as companies see increased energy savings coupled with more controllability and value-add services with this technology. Significant growth is expected within the LaaS market, but LaaS is still a small share of overall lighting-related revenue.

Globally, North America is anticipated to maintain the largest market share of revenue over the forecast period, followed closely by Europe. Current penetration is estimated between 30% and 40% in North America and between 20% and 30% in Europe. In Asia Pacific, connected lighting has yet to achieve widespread adoption, but the large building stock and potential overlap with asset tracking objectives make LaaS a strong business opportunity in the region. Latin America makes up a small portion of global LaaS revenue along with the Middle East & Africa. These regions have been slower to adopt lighting controls and building management technologies; therefore, the benefits of connected LaaS have yet to drive market opportunities.

***Chart 1 LaaS Revenue by Region, World Markets: 2021-2030***



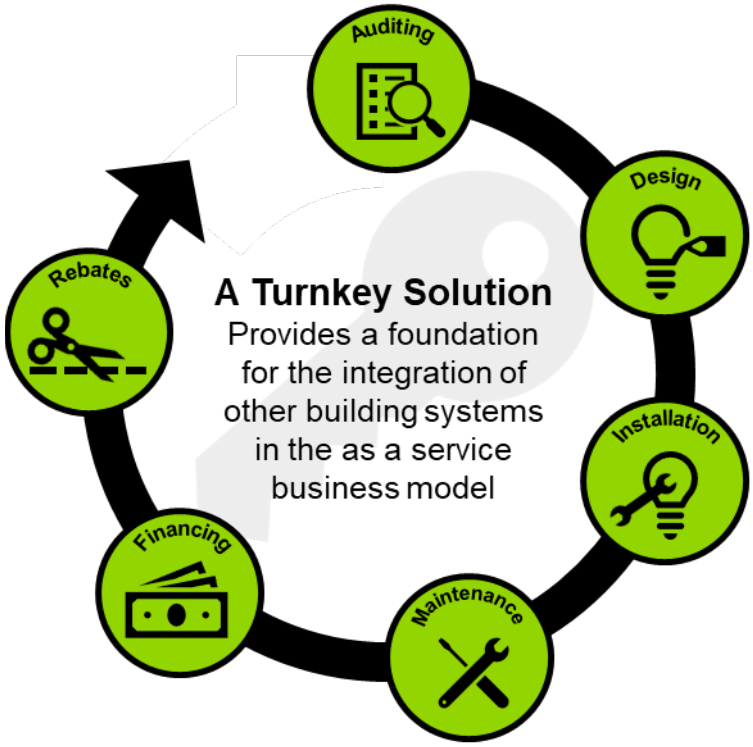

*(Source: Guidehouse Insights)*

Turnkey services, an all-inclusive LaaS offering, is a growing service area within LaaS contracts. With a turnkey solution, the lighting vendor provides all aspects of a lighting system:

- **The plan and design stage** allows the provider to audit existing lamps and luminaries, including lamp types. This stage also allows the provider to gather data on utility expenses and floor plans and create a customized solution for each building owner or operator's needs and verify compliance with local, state, and government building codes and regulations.
- **Installation** includes removing old luminaires, fitting the new equipment, and commissioning the lighting system, such as lamps, luminaires, and controls (if applicable).
- **Operation, maintenance, and optimization** fall under an umbrella of program management of a lighting system. This area incorporates life cycle maintenance, system optimization and commissioning, and continued support for the building.
- **Financing and rebates** include aspects of the traditional financing model. In addition, this step includes research for and application of manufacturer, utility, and government rebates that can be applied to the cost of the system, increasing client savings.

Turnkey LaaS offerings provide a manufacturing facility with the option to have a high functioning lighting system without the required knowledge of operating a connected lighting system complete with sophisticated software and controls. This provision allows companies to prioritize core areas of their business rather than taking time to focus on the operations of their lighting systems. Turnkey LaaS offerings also offer the foundation for integration of other building systems into the as a service business model.

***Figure 2 Turnkey LaaS Solutions Provide a Foundation for Integration***




*(Source: Guidehouse Insights)*

## Signify's LaaS Offering

Signify's connected lighting systems, intelligent control systems, and software increase occupant safety, productivity, and comfort. Signify's LaaS offering can be remotely managed to adapt lighting and provide actionable insights that help create a safe work environment. LED lighting provides long-term safety by giving customers the ability to adjust light levels and quickly and easily improving visibility at the facility. Sensors and data analytics capabilities provide historical and real-time data on lighting system activities and trends to improve functionality and maintenance. Building managers can remotely assess, optimize, and manage energy usage, lighting conditions, space and safety requirements, and workplace designs. In particular, Signify's connected lighting system offers luminaires with integrated sensors capable of sharing data on occupancy, activity patterns, temperature, humidity, and daylight levels.

The sensor technologies underpinning Signify's connected lighting services detect light levels and collect data on energy consumption and usage. This data can be used to tweak lighting settings or predetermine lighting schedules based on planned activities and operations. The as a service component takes the control system off premises, migrating the data and control to the cloud. Any end user in a manufacturing environment who wants to shift responsibility to the service provider for lighting to maximize efficiency and cost savings can adopt LaaS. The data and control systems' functionality is scalable, including options for presence detection and occupancy tracking. Signify customers own and have access to their data, which Signify agrees to aggregate for internal business use only. Signify does not store or share any customer data beyond contract terms.

With Signify's LaaS offering, customers receive the technology and subscription service in addition to support on installation and maintenance and control systems. Signify outsources installing lighting systems correctly and efficiently and maintaining lighting systems to lighting experts and technicians. The company employs control system experts who travel to customer locations in the first or second year of a contract, even for remote LaaS operations. These lighting specialists assess the connected lighting systems, analyze the data and efficacy of the system since installation, and recommend any adjustments to optimize the system on a case by case basis. These visits also allow customers to provide Signify with direct feedback. LaaS can also provide a sustainable test case for the integration of other data and control systems purchased and operated as a service from a third-party provider.

## Real World Examples

As a vendor of LaaS, Signify owns the lighting and luminaries that they provide and install, charging a monthly service fee for controlling illumination levels and performing software updates and maintenance. At the end of a 10-year contract, end users have the option to extend Signify service or buy back the lighting equipment to own and operate in house. Signify's technology is currently deployed in many use cases across several industry verticals, including retail, manufacturing, transportation, sports, and horticulture. As a case study in adopting a circular economy strategy in Europe, Signify has deployed LaaS at the Schiphol Airport; at the High Tech Campus research park in Eindhoven, the Netherlands; and with Bruynzeel, a Dutch manufacturer of shelving and cabinetry in the Netherlands. These contracts include KPIs for specifying lighting levels and reusing materials and luminaries. For one customer, a medical device wholesaler, Signify's LaaS provided an opportunity to renovate lighting by adopting a circular pathway in line with circular economy initiatives. Feedback from the customer about the new lighting system indicated a positive impact on the health and wellness of its employees.

In Spain, one Signify customer in the steel and mining industry replaced more than 800 metal halide lamps and 50,000 fluorescent tubes in over 120 production and commercial locations. Before upgrading to Signify's LaaS and replacing lighting with LEDs, the customer had yellow-colored lighting and experienced frequent outages and maintenance. After Signify's installation, the customer experienced white light and received an award for the level of materials recycled in the renovation. Feedback from the customer about the new lighting system showed positive impacts on energy savings, relief from maintenance responsibilities, and improved working conditions. The customer also highlighted the ease of communication with and responsiveness of Signify, stating that one email is enough to resolve any issue.

In 2020, Signify entered into a 6-year contract agreement with a European industrial company deciding to upgrade to LED lighting as part of a renovation project for one of its largest locations. With locations in over 80 countries, the company supplies over 3 million customers worldwide. The Signify LaaS solution was selected by the company to achieve increased energy and maintenance savings on its balance sheet. The contract replaced lighting fixtures on a 1:1 ratio in the most used areas of the industrial site during hours of operation, including workspace, office space, storage, and parking areas. The solution also provides enhanced lighting in areas used for product quality control and testing. Before installation, Signify conducted a full equipment audit of existing lighting and completed a systems design for its connected lighting service. The Signify service solution included the removal of old luminaries, recycling and disposal of existing materials, installation of new LED luminaries and their designated power meter, and testing and configuration of the replacement system. As a result, Signify handled full management of the new lighting system, including operations, maintenance, performance, data analytics, training, and record keeping.

Pricing for Signify's LaaS solution is a fixed-term annual subscription over the contract lifetime beginning after the new lighting system has been installed, tested, and certified to meet operational standards. Signify's KPIs for this customer included commitments on installed power capacity, light levels and luminosity, and 90% uptime as a measure of total non-operational luminaries compared with the total number installed. All KPIs are compared against the performance of the replaced lighting system year to year. The annual energy and maintenance savings for the customer over the contract period averaged €2,156 ($2,581) per year. Compared to the existing solution, the Signify LaaS generated €2,282 ($2,732) in savings in year 1 for the site, with cumulative net savings projected to reach €103,908 ($124,535) by year 6. Annual $CO_2$ emissions were reduced by a measure of 26 $TCO_2$ or total $CO_2$ per year for the duration of the contract. Based on these projections, the savings derived from the Signify LaaS solution for this customer will exceed the total price of the installation and service fees by year 6.

# Conclusions and Recommendations

- **Embrace as a Service Models:** There has been a growing trend of shifting business models to as a service, not only in software and commercial markets but also in residential, consumer, energy, and transportation markets. Adoption of LaaS requires a paradigm shift in thinking regarding lighting and connected technology and a shift from CAPEX to OPEX spending. LaaS offerings can include a wide range of features and functionality that can be built into subscription services that vary from vendor to vendor and client to client, as these solutions are highly customizable and often tailored to meet individual needs. Preparing this transition and its requirements before selecting a vendor will allow end users to place more emphasis on selecting the right system and service capabilities. Further adoption of these technologies should lead to healthy competition for the most robust and sustainable solutions.

- **Promote Sustainable Business Relationships:** Through the benefits of this emerging business model and the increased creation of long-term relationships, the ecosystem of providers is shifting. Lighting manufacturers are expanding relationships and developing trust with existing customers. Beyond lighting vendors, companies already involved in retrofits and facilities management can gain footing in the LaaS market by providing services through all stages of a lighting upgrade from planning and design to installation, management, and system maintenance. These bolstered and extended relationships encourage sustainability and enhance customer service across the market.

- **Enhance Safety and Reliability:** Executives and managers are committed to safe and reliable operations, which can only be strengthened by upgraded and enhanced lighting systems. Connected lighting, LaaS and lighting controls can help to ensure a safe workplace and provide evidence of compliance with regulatory requirements. Additional data insights can provide new advantages for business operations and outputs while producing energy and cost savings that can be reinvested into production and operations. Energy savings and efficiency are essential features for building upgrades in line with global sustainability goals and leading in this area can be a boon for company reputation.

- **Explore the Long-Term Potential for LaaS:** The LaaS business model incentivizes long-term investment, rewarded with upfront savings. The future of LaaS will likely continue to scale to meet customer requirements, integrating data from Internet of Things devices, and adapting to meet human-centric needs. As more service models add value across manufacturing, connected lighting and LaaS offer a low cost, high reward solution for lighting replacement and upgrade initiatives.

# Notes

CAGR refers to compound average annual growth rate, using the formula:

$$CAGR = (End\ Year\ Value \div Start\ Year\ Value)^{(1/steps)} - 1.$$

CAGRs presented in the tables are for the entire timeframe in the title. Where data for fewer years are given, the CAGR is for the range presented. Where relevant, CAGRs for shorter timeframes may be given as well.

Figures are based on the best estimates available at the time of calculation. Annual revenue, shipments, and sales are based on end-of-year figures unless otherwise noted. All values are expressed in year 2021 US dollars unless otherwise noted. Percentages may not add up to 100 due to rounding.

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