CASE STUDIES

SMART EPC

SMART EPC

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Executive summary

Energy Performance Contracting (EPC) is a financing approach that enables capital improvement through energy upgrades. This model involves External Service Companies (ESCOs) implementing energy efficiency or renewable energy projects, with costs repaid through the generated savings. Public lighting systems, crucial for Smart City applications, provide an ideal infrastructure for such projects. Smart EPC leverages connected public lighting systems with LED luminaires to address challenges faced by modern cities. This approach integrates additional services like environmental monitoring, EV charging, and communication technologies into the public lighting infrastructure.

Modern cities strive for a sustainable energy balance, environmental responsibility, efficient communication services, effective city management, citizen well-being, and global positioning. Smart EPC aims to upgrade public lighting systems with connected luminaires, environmental monitoring sensors, EV charging solutions, and communication technologies with the goal to monetize these services at the same time.

Implementing connected lighting with additional services raises questions about securing power infrastructure, deploying infrastructure fast and simply, and ensuring non-intrusive installations. Challenges specific to street-side 5G solutions, environmental monitoring and EV charging are discussed, emphasizing the need for careful planning and adherence to regulations. At the same time, integration of such services offers numerous benefits as improved 5G experiences, minimal visual impact, increased broadband connection points, city life quality enhancement, pollution heat maps and new revenue streams.

The document provides case studies of pilot projects in various cities, showcasing successful implementations of Smart EPC concept for public lighting systems. Examples cover Smart City applications, EV charging as a commercial energy service, and communication technologies as a non-energy service. By integrating additional services into existing infrastructure, cities can achieve sustainability, citizen well-being, and global competitiveness which presents a comprehensive solution to modern urban challenges. The document emphasises the importance of careful planning and adherence to regulations to overcome challenges and maximise the benefits of Smart EPC.

Smart public lighting by using energy performance contracting (EPC)

Smart public lighting - challenge and solution concept

Energy Performance Contracting (EPC or EnPC) is a form of 'creative financing' for capital improvement which allows funding energy upgrades from cost reductions/savings. Under an EPC arrangement, an external organization (ESCO) implements a project to deliver energy efficiency, or a renewable energy project. It uses the stream of income from the cost savings, or the renewable energy produced, to repay the costs of the project, including the costs of the investment. Essentially, the ESCO will not receive its payment unless the project delivers energy savings as expected.[1]

The approach is formed on the transfer of technical risks from the client to the ESCO based on performance guarantees given by the ESCO. ESCO remuneration outcomes from demonstrated performance; a measure of performance is the level of energy savings or energy service. EPC is a mean to deliver infrastructure improvements to facilities that lack engineering skills, manpower or management time, capital funding, understanding of risk, or technology information. Cash-poor, yet creditworthy customers are, therefore good potential clients for EPC.[1]

Public lighting system can be easily recognised to have all above-mentioned characteristics. Besides, public lighting also plays a pivotal role in the development of most of the Smart City applications by providing physical and electrical infrastructure suitable for most of the Smart City sensors, communication and IoT devices, cameras, loudspeakers, displays etc.

In recent years, significant development has been invested in public lighting systems in order to enable maximum energy efficiency, minimum environmental load, high level of connectivity and embedded intelligence, as well as to enable it to function as energy and communications backbone for Smart City applications integrated in its infrastructure. There are various pilots and projects in modern cities worldwide tailored around integration of Smart City applications in public lighting systems infrastructure. This development goes further by learning and adapting the experiences gained from these projects.

In short, modern cities face the following challenges:

- energy balance ensuring;
- environmental sustainability;

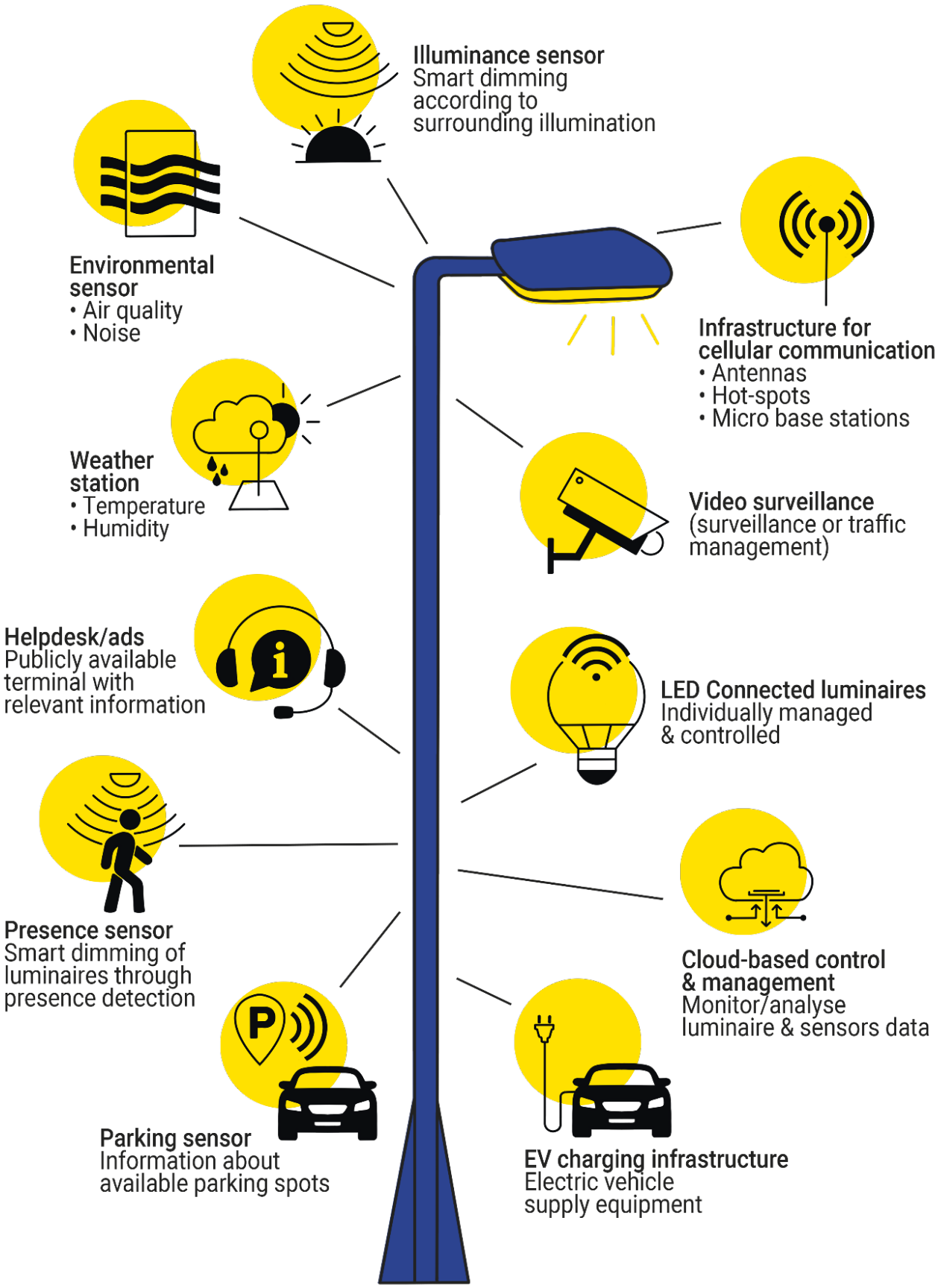
- communication services development;
- city management operation;
- citizen well-being ensuring;
- global city branding and positioning.

The key solution to address some of the above-mentioned challenges would be the upgrade of public lighting systems with LED connected luminaires. However, some of the challenges need to be additionally addressed such as citizen well-being, city management and communication services.

Hence, the concept behind Smart EPC is to get the most out of the smart public lighting system infrastructure to be able to monetize on additional services such as Smart City applications, e.g. environmental monitoring (that would allow local authorities to work more efficiently on citizen well-being and to have basis for sustainable urban development plans), EV charging solutions to increase sustainable mobility and last but not least, Communication technologies, e.g. street level 5G base stations (that allow for more connectivity with no need for building and construction permits extraction and additional infrastructure).

The ideal case would be the following:

- connected public lighting system infrastructure powered by the standard grid;
- environmental monitoring equipment mounted on the lampposts to provide a grid of sensors that will give a clear picture (heat map) of air quality, noise level or temperature level (Smart City applications);
- EV charging solutions integrated within the lampposts;
- Communication technologies e.g. street side 5G base station solutions for mobile connectivity, mounted on lampposts.

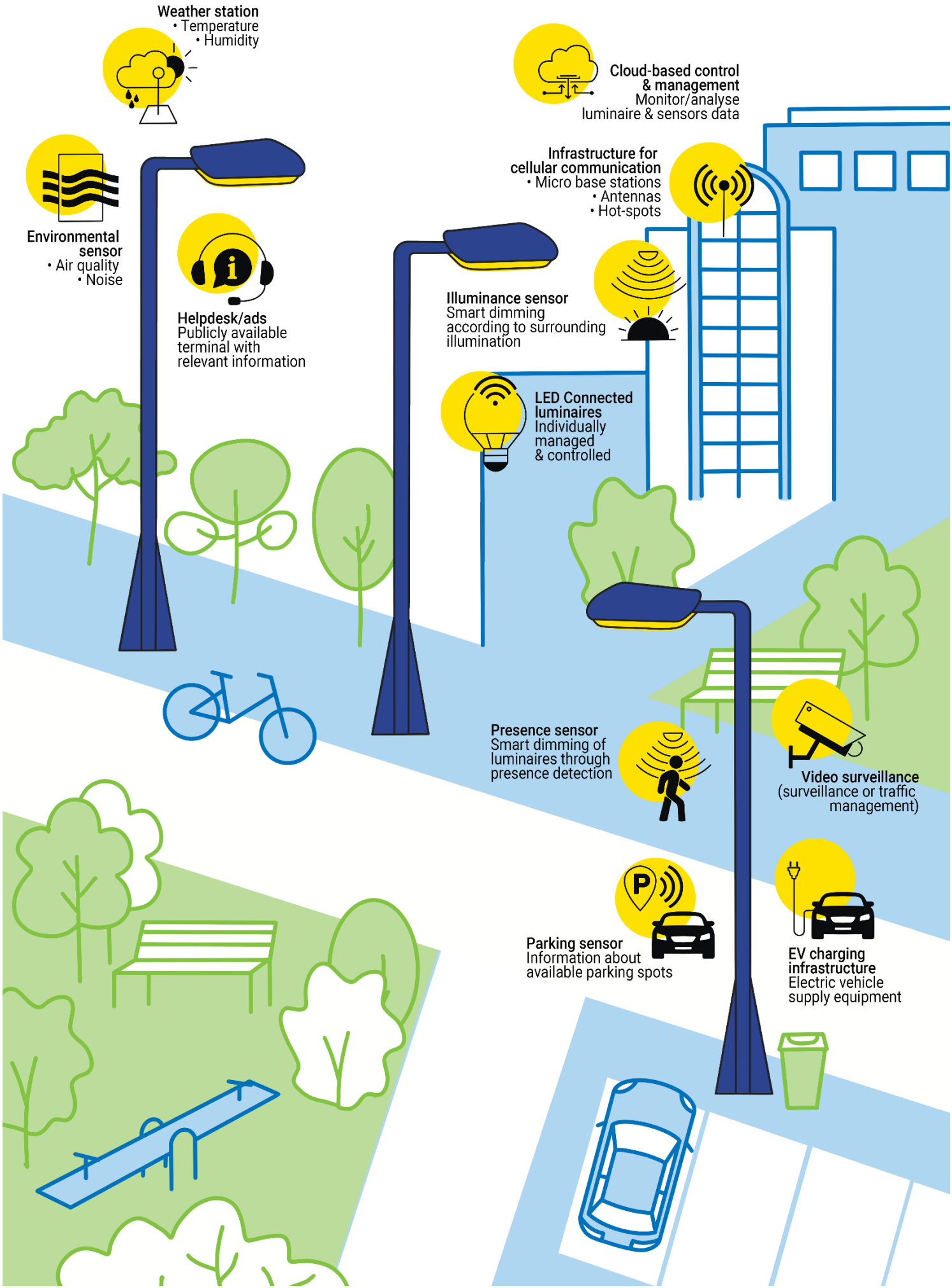

Illuminance sensor
Smart dimming according to surrounding illumination
Environmental sensor
• Air quality
• Noise
Infrastructure for cellular communication
• Antennas
• Hot-spots
• Micro base stations
Weather station
• Temperature
• Humidity
Video surveillance
(surveillance or traffic management)
Helpdesk/ads
Publicly available terminal with relevant information
LED Connected luminaires
Individually managed & controlled
Presence sensor
Smart dimming of luminaires through presence detection
Cloud-based control & management
Monitor/analyse luminaire & sensors data
Parking sensor
Information about available parking spots
EV charging infrastructure
Electric vehicle supply equipment

Solution overview

The prime purpose of modern cities is to provide a high level of well-being to their citizens while not deteriorating the environment of surrounding areas. This way, the city is well-positioned globally in everlasting competition with other urban centres worldwide.

The first challenge of modern cities is the sustainable balance of the total energy provided to the city with the one consumed by the city. This challenge gets more and more important each day. The other very important factor is environmental sustainability. A very important task is to reduce waste generation load by every system used in modern cities, especially the one related to hazardous and polluting substances. The other important aspect is the issue of light pollution in modern cities, affecting human health, stability of biological ecosystems and preservation of dark skies environment important to astronomical observation, the well-being of citizens and tourism. As much as the life of a modern person gets increasingly complex and multidimensional, the overall management of city life gets increasingly complex each year in all aspects. City management requires a complex and smart integrated IT backbone, open and interactive to citizens and all city management service organizations. City also needs to be interconnected with the whole country and global people, information, goods, and energy networks. This Management system needs to be a live and interactive flexible system growing, adapting, and developing with a city. **Citizen well-being means that city life is adjusted to citizens in terms of all their daily needs, sensing the life of the citizens, adapting to it and interacting with it.** The modern city needs to adapt to the daily rhythms and movement patterns of its citizens.

By providing a high level of citizen well-being and a healthy integration within its county and the international community, the city advances in its global positioning and branding. This is also highly interconnected with the spirit of uniqueness and creativity expressed by the city and its citizens. The better the city's global perception and positioning, the quicker prosperity of a city.


Weather station
• Temperature
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Cloud-based control & management
Monitor/analyse luminaire & sensors data
Infrastructure for cellular communication
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Video surveillance
(surveillance or traffic management)
Parking sensor
Information about available parking spots
EV charging infrastructure
Electric vehicle supply equipment

Challenges

When thinking about the complete solution (connected lighting with additional services infrastructure) common questions arise:

- how to secure power infrastructure for the additional services?
- how to deploy the additional infrastructure (sensors and 5G antennas) fast and simple?
- how to deploy non-intrusive infrastructure (EV charging points)?

The questions above present a challenge when trying to improve and enrich EPC projects. The case is that every available service, in addition to connected public lighting, has a set of rules for implementation that needs to be followed. Although installation of connected public lighting might seem fairly simple process, as it only envisions the replacement of traditional lampposts, it might be a complex project. Detailed construction and development plans must meet the regulatory, legal and planning demands. Additionally, every additional service must consider the set of assumptions, prerequisites and constraints:

Challenges - Street side 5G solutions

Communications service providers are challenged on the footprint, rent and OPEX of macro sites and those challenges are even more present at the street level. New street and outdoor small-cell solutions can be mounted on existing infrastructure. They are fast to install, with a subtle footprint and secure the 5G experience. Delivering industry-leading innovations is no small feat in the mobile operators' industry.

The questions that arise with urban 5G roll-outs are:

- How to acquire sites with the minimum rental?
- How to deploy fast and simple?
- How to maximize the 5G user experience?
- How to deploy non-intrusive 5G sites?
- How to utilize all frequency layers in a best way?

As 5G network roll-outs continue globally, the need for network densification will continue to grow. According to the Ericsson Mobility Report 2016[2], cellular data traffic was expected to grow nine times by 2020, placing a unique demand on mobile network operators to provide the necessary infrastructure and density required to serve the market. On top of this, operators are struggling to acquire new cell sites in public areas to provide the best possible mobile broadband coverage for their customers.

Challenges - Environmental monitoring

Air pollution, often referred to as the "invisible killer", is one of the biggest public health risks worldwide. According to Harvard University, the presence of harmful gases and particles in the atmosphere results in 8.7 million premature deaths per year, roughly 20% of all deaths.[3]

Tourism and travelling have become an important part of modern-day life, but they, among many positive, have a number of negative consequences. Environmental impact is probably the most obvious one. It consists of many different aspects, such as the depletion of natural resources like water and land, discharging waste, pressure on endangered species, noise pollution, carbon footprint and many others. One of the aspects, which is hard to notice at first, is the impact on the air quality.

When monitoring environmental parameters in urban areas, the following questions arise:

- How to deploy sensors fast and simple?
- How to secure power infrastructure?
- How to deploy non-intrusive sensors?
- How to utilize existing infrastructure in a best way?

The importance of clean air is obvious when it comes to health and life quality, but research also shows its influence on tourist demand. High levels of SO_2, PM2.5, PM10 and NO_2 have a strong negative impact on the number of tourists in that area.

Challenges - EV charging

There are several reasons why the lamppost is in the spotlight for EV charging such as existing infrastructure, ubiquitous and common placement throughout most urban spaces. Public lighting systems are already connected to a power supply and, in residential areas especially, where space is at a premium, it makes sense to utilize street furniture that has already been installed, rather than further adding to street clutter.

A key reason that EV charging facilities are integrated into public lighting system infrastructure is that it is significantly cheaper than new on-street charge points and their connection to the power grid. This, combined with the drive for EV take-up where more electric cars are anticipated on the street, means the necessity for charging infrastructure to support it. Since pavements don’t have the capacity to accommodate additional applications, public lighting holds the answer.

The key challenge here is to separate the electric supply used for public lighting, other services and EV charging. The architecture should be done in a way that it protects all the assets in case of failure or overload. Additionally, the EV charging stations should be integrated only at the locations where it makes sense to put a parking place for EVs to charge.

Key benefits of additional energy and non-energy related services on public lighting

Given the assumption that the full stack service offering is available on a particular location, here is a list of key benefits per the service offered on top of the connected public lighting:

Key benefits - Street side 5G solutions:

- Deliver street side solutions and leverage smart public lighting capacity and infrastructure to ensure 5G experience;
- Integrating into any streetscape with minimum visual impact;
- Increased broadband connection points;
- Detect failed lampposts;
- Low power consumption for sustainability goals.

Overall, the case is that the owner of the smart public lighting infrastructure can benefit even more (financially) by giving into concession the infrastructure (lampposts), which for sure is appealing to CSP's as they are mitigating the challenges faced when trying to deploy 5G base stations in a traditional way (own infrastructure).

Key benefits - Environment monitoring

Installing various environment sensors (heat or air quality) on existing or connected lampposts solutions creates new service opportunities and allows city officials to create an ecosystem that will allow making informed decisions on improving the quality of life. The results of such an integrated solution are:

- Integrating into any streetscape with minimum visual impact;
- Improving city life quality;
- Generate pollution heat maps;
- Low power consumption for sustainability goals.

Key benefits - EV charging

Integrated EV charging points offer a cost-effective and creative approach to siting and installing public charging stations. In addition, they present an important tool that can help expand access to EV charging. The key benefit of implementing the EV charging into lampposts besides driving sustainable mobility (the key thing to achieving climate goals is to turn electric, but also it needs to be complemented by appropriate infrastructure) is also an **open position for a new revenue stream**. CSP's offering such services would probably be delighted to be able to place EV chargers by paying the concession to the existing infrastructure (lampposts).

In the next **case studies**, examples of pilot projects in the field of implementing energy and non-energy-related services on public lighting are given. The best existing solutions to emerging challenges have been described in detail, with focus on three different areas:

- Smart public lighting as the basis for Smart City applications:
  Paris (FR), Tampere (FI), Sabinov (SK), 2x Krakow (PL), Santander (ES), Seville (ES), Haute-Savoie (FR);
- Smart City – EV charging as commercial energy service:
  Greater London (UK), Los Angeles (US);
- Smart City – Communication technologies as commercial non-energy service:
  Kazan (RU), Al-Wakrah (QA).

References:

1. European Energy Efficiency Platform (E3P), (2022, June 28), Energy Performance Contracting, Energy Performance Contracting | E3P (europa.eu)
2. Ericsson, (2022, June 28), Ericsson Mobility Reports, Past and present reports - Mobility Report - Ericsson
3. Burrows, Leah, (2021, February 1), *Deaths from fossil fuel emissions higher than previously thought*, Deaths from fossil fuel emissions higher than previously thought (harvard.edu)

Paris, France

Improving sustainability and wellbeing while serving as Smart City backbone

Case study:
Smart public lighting

Industry:
Local authorities

Executive summary

With the direct impact on energy savings, environmental sustainability and citizen wellbeing, modern public lighting serves at the same time as infrastructural backbone for other Smart City services, providing mechanical and electrical infrastructure to sensing, communication and engagement devices. Smart public lighting is cloud connected and open for vertical and horizontal integration with other Smart City applications. The system is fully prepared for asset management data integration.

The challenge:

City management has become more complex in recent decades. Integrated management of different systems is becoming more and more important.

City life has its daily rhythms and citizen have their own daily movement patterns inside the city. City infrastructure needs to adapt and follow these natural cycles providing a maximum of citizen well-being.

Cities compete globally for international positioning and branding. Unique visual image of the city is one of the key factors of its international recognition and reputation.

Modern Smart City systems require an increasing number of peripheral devices, sensors, detectors, cameras, communication base stations, actuators, signal devices, loudspeakers and displays. All this equipment needs 24/7 mechanical, electrical and communication infrastructure.

Smart City systems need systematic data management to enable cost-effective planning, contracting and maintenance. Good city asset management provides substantial financial savings to the City.
All the above issues point to the need for Smart City infrastructure across the city that is:

- Energy efficient
- Long lasting
- Intelligent and flexible
- Connected
- Digitally traceable
- Open
- Future proof

At-a-glance

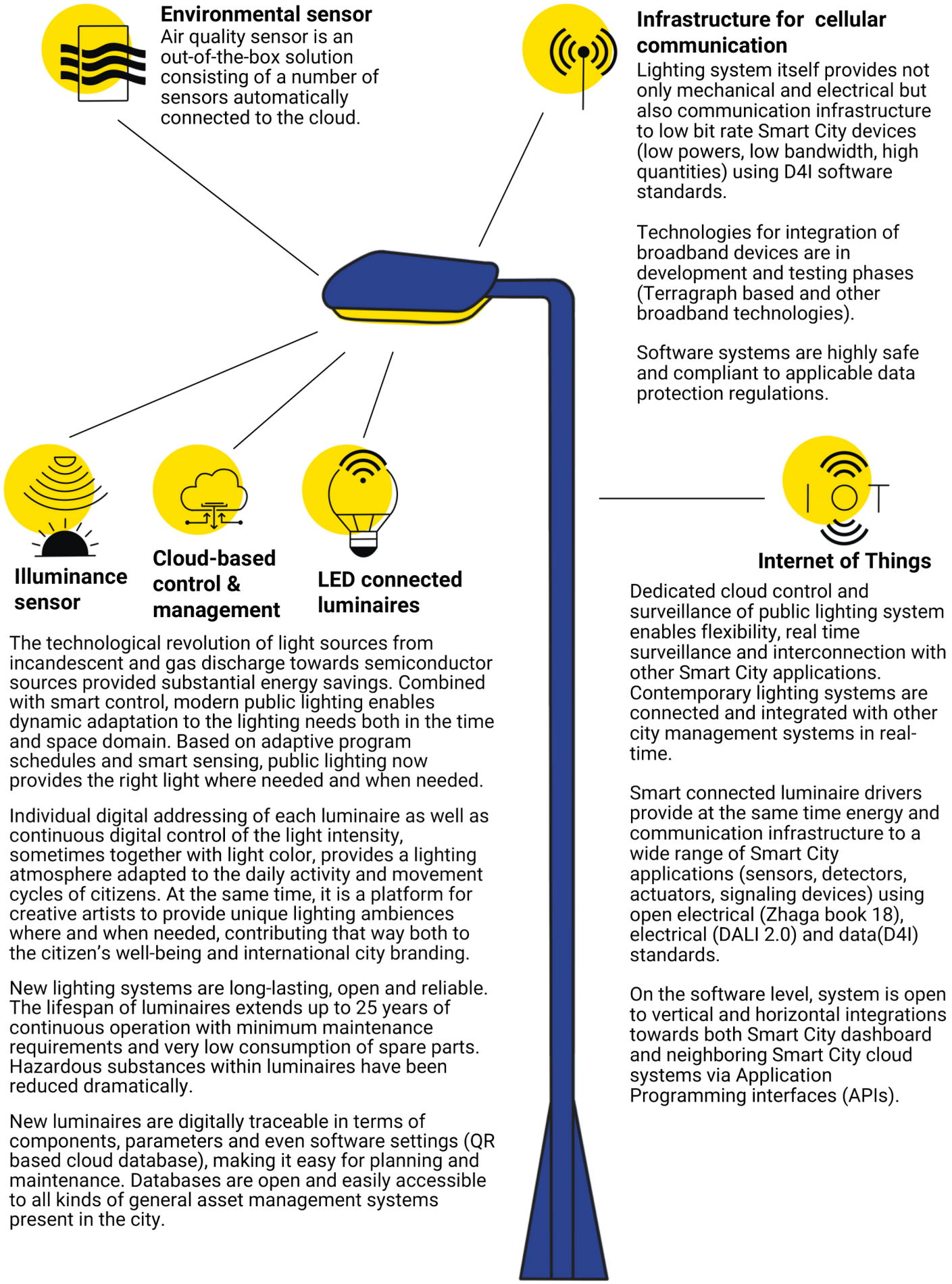
Goal:
- Energy savings;
- Light pollution decrease;
- Integration with Smart City management;
- Infrastructure for general Smart City peripheral equipment;

Approach:
- Use state of the art lighting and communication technologies;
- Enable open, future proof and safe software platform;

Results:
- Reduction of energy consumption;
- Reduction of waste;
- Reduction of light pollution;
- Flexible and vibrant light atmosphere;
- Quick and easy way to install Smart City applications;
- Open and integrated cloud platform;

Featured solutions:
- Smart connected drivers;
- Bidirectional communication channels towards sensors, actuators and communication devices;
- Long lasting and green electronic components.

The solution:



Environmental sensor
Air quality sensor is an out-of-the-box solution consisting of a number of sensors automatically connected to the cloud.

Infrastructure for cellular communication
Lighting system itself provides not only mechanical and electrical but also communication infrastructure to low bit rate Smart City devices (low powers, low bandwidth, high quantities) using D4I software standards.

Technologies for integration of broadband devices are in development and testing phases (Terragraph based and other broadband technologies).

Software systems are highly safe and compliant to applicable data protection regulations.

Illuminance sensor

Cloud-based control & management

LED connected luminaires

Internet of Things

Dedicated cloud control and surveillance of public lighting system enables flexibility, real time surveillance and interconnection with other Smart City applications. Contemporary lighting systems are connected and integrated with other city management systems in real-time.

Smart connected luminaire drivers provide at the same time energy and communication infrastructure to a wide range of Smart City applications (sensors, detectors, actuators, signaling devices) using open electrical (Zhaga book 18), electrical (DALI 2.0) and data(D4I) standards.

On the software level, system is open to vertical and horizontal integrations towards both Smart City dashboard and neighboring Smart City cloud systems via Application Programming interfaces (APIs).

The technological revolution of light sources from incandescent and gas discharge towards semiconductor sources provided substantial energy savings. Combined with smart control, modern public lighting enables dynamic adaptation to the lighting needs both in the time and space domain. Based on adaptive program schedules and smart sensing, public lighting now provides the right light where needed and when needed.

Individual digital addressing of each luminaire as well as continuous digital control of the light intensity, sometimes together with light color, provides a lighting atmosphere adapted to the daily activity and movement cycles of citizens. At the same time, it is a platform for creative artists to provide unique lighting ambiences where and when needed, contributing that way both to the citizen's well-being and international city branding.

New lighting systems are long-lasting, open and reliable. The lifespan of luminaires extends up to 25 years of continuous operation with minimum maintenance requirements and very low consumption of spare parts. Hazardous substances within luminaires have been reduced dramatically.

New luminaires are digitally traceable in terms of components, parameters and even software settings (QR based cloud database), making it easy for planning and maintenance. Databases are open and easily accessible to all kinds of general asset management systems present in the city.

Tampere, Finland

Wireless connectivity through public lighting system

Case study:
Smart public lighting

Industry:
Local authorities

Executive summary

Signify and Edzcom deliver wireless connectivity through existing public lighting system infrastructure in the City of Tampere. The City planned to use new technology to advance their digital agenda to improve digital services by providing a highly connected environment. Objective was to become a zero-crime city and use Smart City solutions to accelerate this.

The challenge:

In the wake of rapid urbanization and industrialization, cities around the world are facing exponential demand for resources such as public transport, housing, water supply and sanitation. These issues cannot be ignored, and Smart City projects aim to tackle them by focusing on how technology can be implemented to improve the lives of citizens and make cities more sustainable in a socially inclusive way.

Signify (Euronext: LIGHT), the world leader in lighting, and Edzcom, a European market leader in Edge Connectivity solutions, are bringing the City of Tampere one step closer to the future. The unique BrightSites solution delivers fast and reliable connectivity to every street corner using the city's own network integrated in public lighting system. It removes the need to lay fiber connections throughout the city, while needing only a fraction of the time and cost of traditional methods. This allows the City of Tampere to accelerate the deployment of present and future broadband IoT applications such as 5G, WiFi and Smart City services.

All complex Smart City systems need systematic data management to enable cost-effective planning, contracting, and maintenance of systems.

At-a-glance

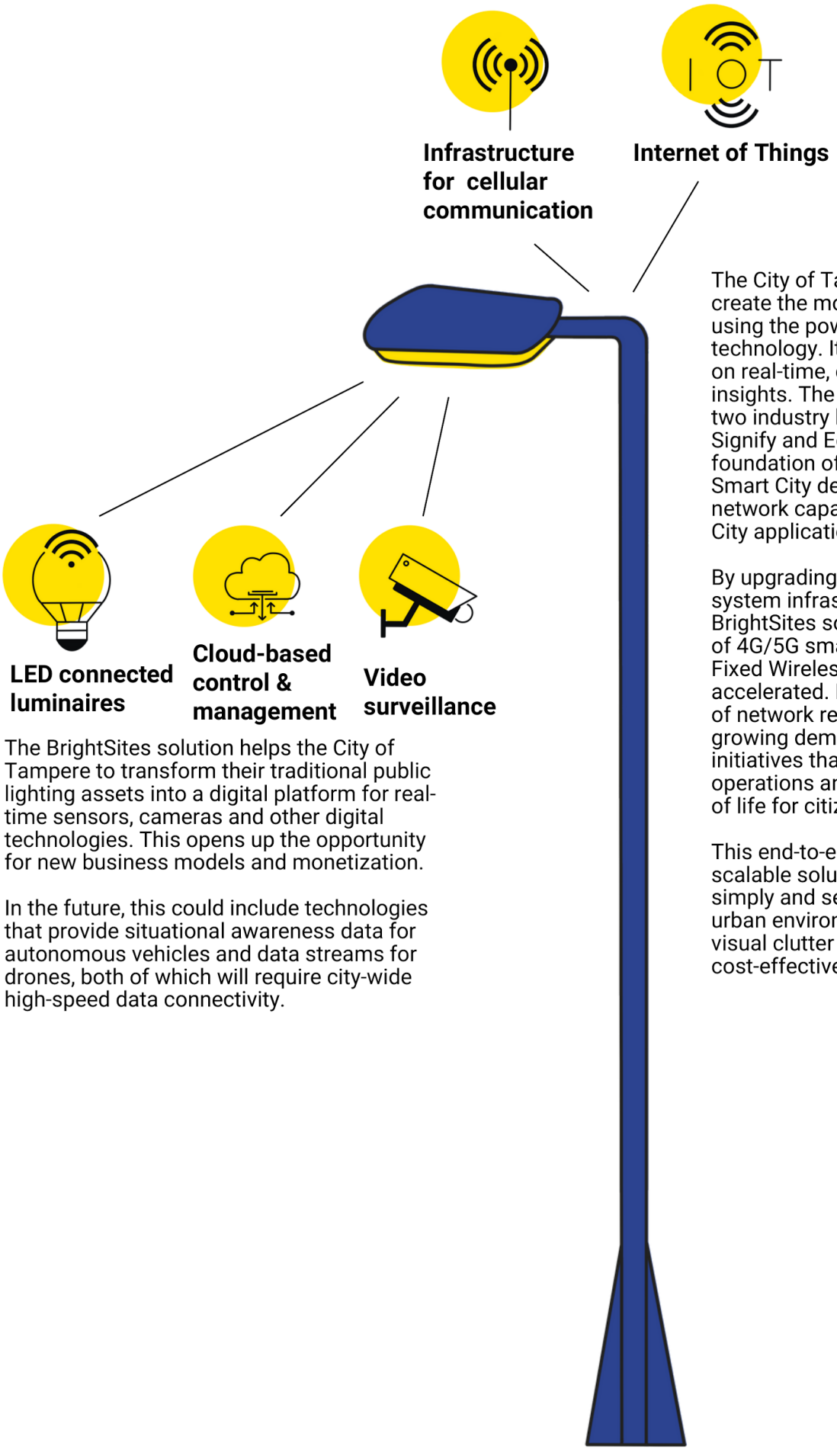
Goal:
• Energy savings;
• Zero-crime city;
• Highly connected environment
• Integration with Smart City management;
• Infrastructure for general Smart City peripheral equipment;

Approach:
• Use most advanced public lighting and communication technologies;
• Enable open, future proof and safe software platform;

Results:
• Reduction of energy consumption;
• Reduction of waste;
• Flexible and vibrant light atmosphere;
• Quick and easy way to install Smart City applications;
• Open and integrated cloud platform;

Featured solutions:
• City of Tampere, Finland, installs BrightSites solution by Signify to provide super-fast wireless communication using high-quality LED luminaires;
• BrightSites leverages existing public lighting infrastructure to deliver city-wide connectivity at fraction of the usual cost. This is the first ever end-to-end solution to solve cities' challenges of connectivity.

The solution:



The BrightSites solution helps the City of Tampere to transform their traditional public lighting assets into a digital platform for real-time sensors, cameras and other digital technologies. This opens up the opportunity for new business models and monetization.

In the future, this could include technologies that provide situational awareness data for autonomous vehicles and data streams for drones, both of which will require city-wide high-speed data connectivity.

The City of Tampere's ambition is to create the most sustainable society using the power of digitalization and technology. It's a society that lives on real-time, data-driven actionable insights. The City has partnered with two industry leading companies, Signify and Edzcom, to create the foundation of such a society for a Smart City deployment: a city-wide network capable of managing Smart City applications.

By upgrading the public lighting system infrastructure with the BrightSites solution, the deployment of 4G/5G small cells, Wi-Fi and Fixed Wireless Access is accelerated. It enables the increase of network reach and caters for the growing demand of IoT led initiatives that optimize City operations and improve the quality of life for citizens.

This end-to-end, wireless and scalable solution can be integrated simply and seamlessly into the urban environment without creating visual clutter in a sustainable and cost-effective way.

Sabinov, Slovakia

Environmental monitoring sensors and EV chargers integrated in highly efficient LED public lighting system

Case study:
Smart public lighting

Industry:
Local authorities

Executive summary

Sabinov is a small city in Slovakia with a Medieval city center, that was typically short on modern technology. The City wanted to start monitoring weather and air quality in the district. Historical data would help them understand if air quality was being improved by increasing the use of EVs and other energy efficiency measures and inform the public in case of poor air quality.

The challenge:

The city of Sabinov was looking for innovative ways to integrate modern energy efficiency solutions in public lighting system. As residents and tourists started using more electric vehicles (EVs), the City decided to reconstruct existing public lighting system by using LED luminaires and EV charging stations integrated in lampposts in the city center.

SEAK Energetics specializes in creating smart lighting solutions. Their public lighting systems solutions are not only providing energy-efficient lighting; they integrate technology for better living. The solutions helps the City in measuring air quality, get real-time weather data and improve energy efficiency.

At-a-glance

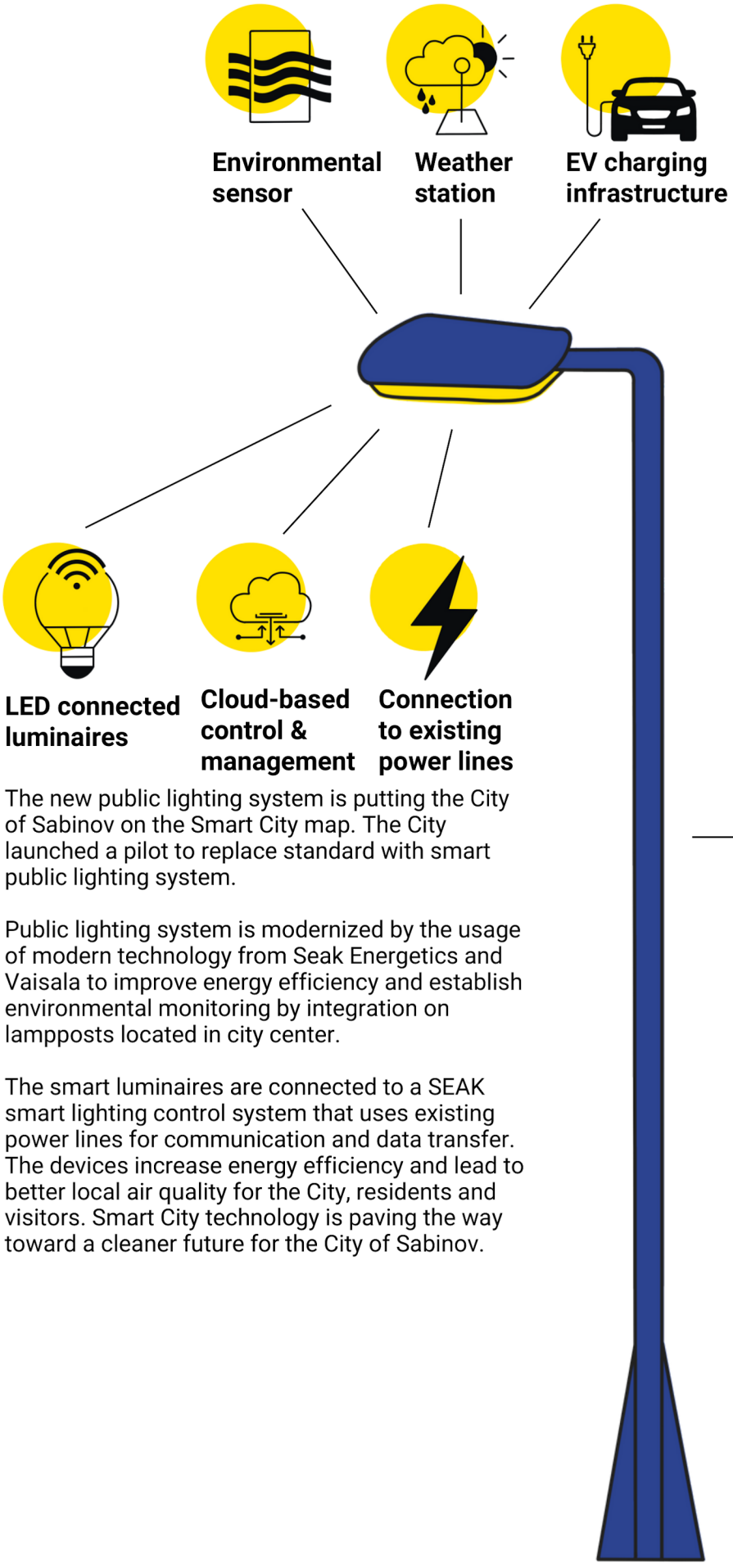
Goal:
- Energy savings;
- Light pollution decrease;
- Integration with Smart City management;
- Infrastructure for general Smart City peripheral equipment;

Approach:
- Use energy efficient lighting;
- Use air quality monitoring to measure impact of increased use of EVs;
- Use air quality monitoring to inform citizens on air quality;

Results:
- Reduction of energy consumption;
- Reduction of waste;
- Reduction of light pollution;
- Quick and easy way to install Smart City applications;
- Open and integrated cloud platform;
- Increased use of EVs;
- Air quality improvement;

Featured solutions:
- Weather transmitter WXT530 (Vaisala);
- Air quality transmitter AQT420 (Vaisala).

The solution:



The new public lighting system is putting the City of Sabinov on the Smart City map. The City launched a pilot to replace standard with smart public lighting system.

Public lighting system is modernized by the usage of modern technology from Seak Energetics and Vaisala to improve energy efficiency and establish environmental monitoring by integration on lampposts located in city center.

The smart luminaires are connected to a SEAK smart lighting control system that uses existing power lines for communication and data transfer. The devices increase energy efficiency and lead to better local air quality for the City, residents and visitors. Smart City technology is paving the way toward a cleaner future for the City of Sabinov.

Each lamppost is integrated with a Vaisala Weather Transmitter WXT530, Vaisala Air Quality Transmitter AQT420 and LUMiCHARGER EV charger.

The all-in-one WXT530 provides the most important weather parameters: air pressure, air quality, air temperature, humidity, rainfall, and wind speed and direction.

The AQT420 provides accurate air quality data on gaseous pollutants (NO2, SO2, CO and ozone O3) and particles (PM2.5 and PM10).

The combined sensors provide a complete picture of current environmental conditions. The sensors are also giving the City greater awareness of their local climate, which will help them determine future lampposts locations.

While the City of Sabinov collects and analyzes data about lighting efficiency and environmental conditions, the Vaisala sensors are helping lay the foundations for weather and air quality awareness.

An app is maintained that provides citizens and visitors with local weather and air quality information, plus having the access to lamppost integrated EV chargers availability at their fingertips.

Real-time air quality monitoring enables the City to alert locals when pollution levels are higher than normal in order to take steps to minimize exposure.

Kraków, Poland

Pilot modernization of public lighting system, along with expansion of telemetry layer and introduction of a control system

Case study:
Smart public lighting

Industry:
Local authorities

Executive summary

The dynamic public lighting control system is one of the most important work results of the Krakow City Roads Authority and the AGH University of Science and Technology, included in the "ISE Krakow" project. The solution, which was implemented in the city of Krakow in 2016, was unique in the world, as confirmed by the lighting industry giants operating in the Polish market: GE Lighting, Schreder and Philips, and telecommunications giant Cisco.

The challenge:

The Board of Roads of the City of Krakow (ZDMK) is a municipal entity that, among many tasks carried out for the City of Krakow, is responsible for the implementation of investment in public lighting system modernization, as well as for maintaining the entire public lighting system infrastructure.

Each year the replacement of hundreds of sodium luminaries with LED luminaries is carried out, resulting with better visibility and improved safety in the city of cca 803 000 residents. Compared to the 50 662 sodium luminaires, 18 473 LED luminaires are installed in Krakow, including 1 320 control and distribution cabinets, as well as 116 cabinets suitable for remote control.

In 2015-2016, the Board of Roads of the City of Krakow in cooperation with the University of Science and Technology, carried out a project entitled Pilot modernization of street lighting in the City of Krakow along with the expansion of the telemetry layer, the creation of a control system and the construction of a PV installation. The project included the installation of 3 768 modern LED luminaires.

The main challenge was to implement a dynamic public lighting control system, which in the future will affect the general principles of lighting operation throughout the city of Krakow.

In this context, the development and verification of methods for dynamic lighting control system in an urban environment became key objectives of the project.

At-a-glance

Goal:
• To implement a dynamic public lighting control system, developing a new scheme for conducting a public lighting modernization project.

Approach:
• To set the general principles of lighting operation throughout the city of Krakow.

Results:
• Installation of intelligent lighting, adjusted according to weather conditions, outdoor lighting and traffic volume;
• Optimization and rationalization of electricity consumption together with reduction in electricity costs;
• Reduction of CO2 emissions.

Featured solutions:
• Dynamic control of public lighting system - CMS (Central Management System) class systems,
• An artificial intelligence based decision-making system, which selects the appropriate normative class of public lighting.

The solution:

Cloud-based control & management

LED

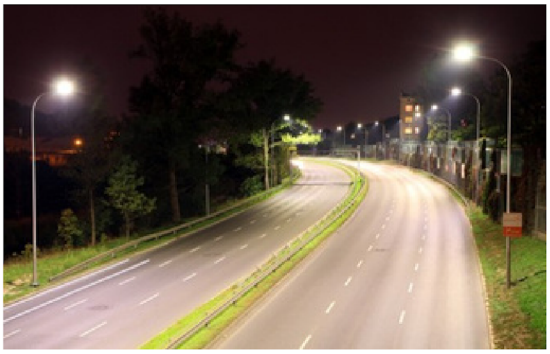
Illuminance sensor

Video surveillance

CMS (Central Management System) class systems, allowing collection of lighting infrastructure inventory, monitoring of lamp operating parameters and various lamp operating modes, are mature solutions with increase of use in public lighting modernization projects.

Dynamic control of public lighting system has been implemented using an artificial intelligence based decision-making system, which selects the appropriate normative class of road lighting based on data collected from:

- induction loops that measure traffic volume;
- video detection of vehicles;
- sensors that measure the intensity of outdoor lighting.



The work on the system included both scientific and domain research, leading to the development of algorithms, methods and data structures and the subsequent practical activities of implementation, deployment and testing.

The project also included other tasks:

- Replacement of public lighting luminaires from sodium to LED;
- Expansion of the telemetry layer of luminaires;
- Installation of a photovoltaic system on one of the university's buildings;
- Purchase of a server to allow operation of the public lighting control system;
- Purchase of licenses for public lighting monitoring system software;
- Purchase of controllers enabling dynamic lighting control for control and power cabinets.

Innovations were introduced at practically all stages of the project - from data collection and processing through the definition of requirements for the system, procurement (e.g., development of bidding parameters), clarification and optimization of the photometric design, to the very phase of operation, supported by the created decision-making system.

Kraków, Poland

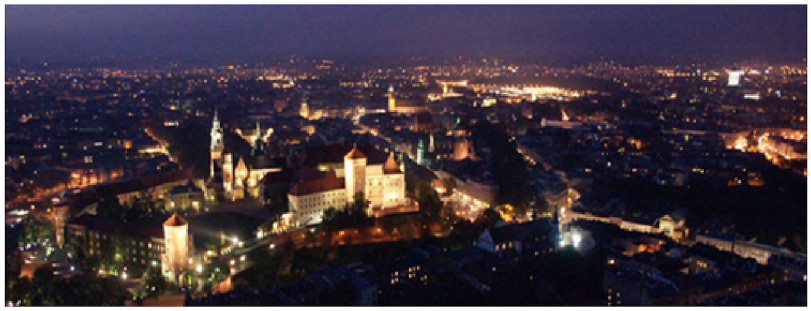
Modernization of public lighting 1998-2000 through ESCO

Case study:
Smart public lighting

Industry:
Local authorities

Executive summary

Although the implementation of EPC projects is still in the development stage, in the late 1990s in Poland it was already possible to meet a venture assuming a similar form of financing. Thanks to the cooperation of the City and the private partner, it has become feasible to finance the public lighting system upgrades at a low cost, as well as reduce the cost of electricity consumption and ongoing maintenance of the public lighting system infrastructure.



The challenge:

After the takeover of the public lighting system infrastructure from the Electricity Company in 1997, during the following period (1998-2000) the Krakow City Roads Authority began the process of public lighting system modernization.

One of the main factors driving the implementation of tasks under public-private partnerships is the limited value of public funds. Development needs of infrastructure and public services favor the involvement of private partners in the project's implementation.

The late 1990s was a period when luminaires, along with other components of the public lighting system, were heavily depleted, resulting in low efficiency of the public lighting system which in most of the city did not meet the required standards. The public lighting system required urgent modernization, using low investment for the City itself.

At-a-glance

Goal:
• Urgent public lighting system modernization, with low public investment.

Approach:
• The involvement of private partner in the project's implementation;
• A return on investment is calculated from financial savings resulting from lower energy consumption as well as lower operating costs after the modernization.

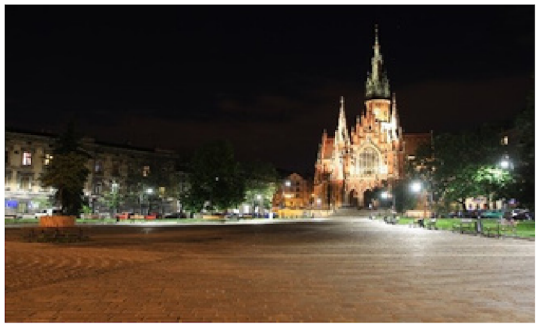
Results:
• Low-cost financing of the investment;
• Electricity consumption reduction;
• Reduction of electricity consumption cost as well as maintenance costs;
• Improved quality and reliability of equipment;
• Extended trouble-free operation time;
• Improved aesthetics of the city.

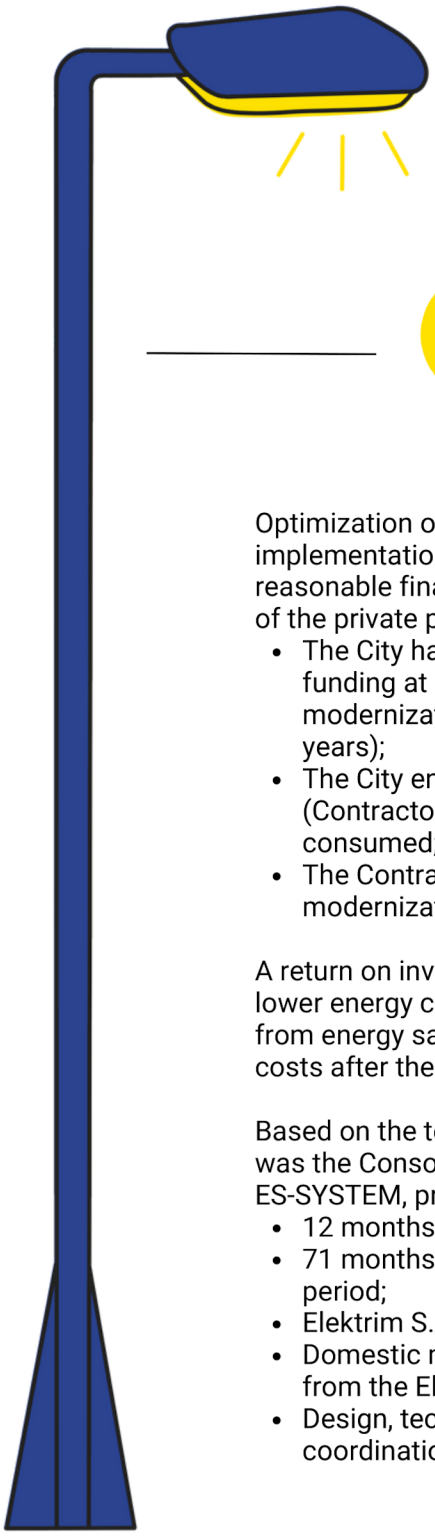
Featured solutions:
• Funding provided by Elektrim S.A.;
• Domestic material supplies provided by Elektrim group of companies;
• Design, technical supervision and coordination provided by ES-SYSTEM.

The solution:

LED

Modernization included 40 461 luminaires, 822 control and power cabinets, 51 010 meters of cables, 2 504 groundings and 589 light poles. Lighting parameters have been improved to enhance the safety of traffic participants and overall safety in the city.





EPC

Optimization of the project referred to its implementation in a way that ensures reasonable financing with the participation of the private partner, i.e.:

- The City has guaranteed to secure funding at a fixed level for the modernization repayment period (6 years);
- The City enabled the private partner (Contractor) to pay less for energy consumed;
- The Contractor financed whole modernization with its own funds.

A return on investment is calculated from lower energy consumption costs resulting from energy savings and lower operating costs after the modernization.

Based on the tender, the selected company was the Consortium of Elektrim S.A. and ES-SYSTEM, proposing:

- 12 months of modernization period;
- 71 months of operational and payback period;
- Elektrim S.A. provides funding;
- Domestic material supplies provided from the Elektrim group of companies;
- Design, technical supervision and coordination provided by ES-SYSTEM.

Santander, Spain

UVAX monitoring and control platform for public lighting

Case study:
Smart public lighting

Industry:
Local authorities

Executive summary

The UVAX solution integrates in one platform all public lighting system management, control, regulation and all Smart City solutions using the electric power network (PLC). This technology has been implemented in the City of Santander, allowing the City to monitor and significantly reduce the energy consumption of 23 000 lighting points thanks to real-time regulation.

The challenge:

Santander is a coastal city located in the north of Spain, capital of the autonomous community of Cantabria, with 171 693 inhabitants (2022).

The Santander City Council is oriented towards guaranteeing the security of the energy supply, its economic efficiency and respect for the environment, and has developed a series of actions whose central axis is the Integral Energy Efficiency Plan.

With the aim of reducing energy consumption during low occupancy hours, public lighting monitoring and control systems needed to be implemented. With this aim, the City needed to tackle the existing situation:

- Antiquated lighting system with no monitoring or regulation and with high energy consumption;
- No inventory or energy audit of the 23 000 lighting points throughout the city;
- Low energy efficiency awareness from the citizens;
- Light pollution.

At-a-glance

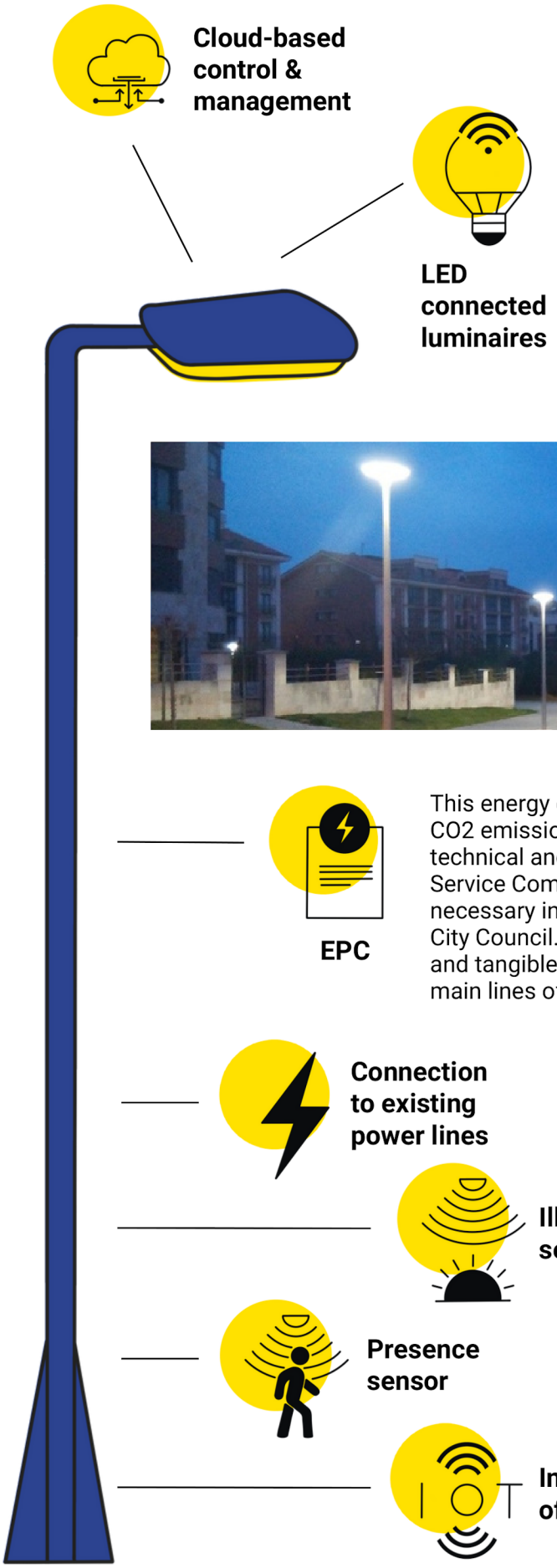
Goal:
• Remote control and management of public lighting system from single place;
• Reduction of CO2 emissions in the city.

Approach:
• Creation of specific study on viability with detailed analysis of public lighting installations;
• Energy audit provision;
• Implementation of tender using ESCO model, for management and replacement of luminaires.

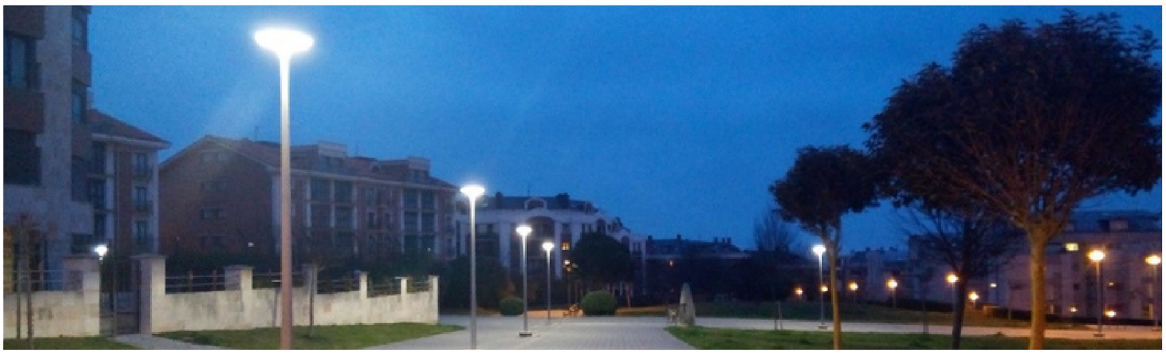
Results:
• Energy savings (from UVAX regulation only): 3 241 MWh/year;
• Energy savings (from both regulation and replacement of luminaries): 13 915 MWh/year;
• Economic savings (from UVAX regulation only): 205 mil EUR/year;
• Economic savings (from both regulation and replacement of luminaires): 1,029 mil EUR/year;
• The realization of an essential and tangible part of Santander Smart City strategy;
• Intensive stimulation of economic activity, generation of employment associated with the activity.

Featured solutions:
• 23 000 luminaires replaced and connected to UVAX;
• The installations renovation without technical and economic risk for the City Council;
• The outsourcing and optimization of the energy management within a framework of public-private collaboration.

The solution:



The City of Santander incorporated 23 000 lighting points to the UVAX system, which was complemented with the replacement of the luminaires. The overall minimum energy savings achieved were 65% compared to the adjusted energy consumption baseline and a reduction of 50% minimum for the power installed for a total investment of 14,3 M EUR. The UVAX system is used for control and monitoring thus providing additional energy savings on the city level and allowing real-time information of each lighting point.



This energy efficiency action was aimed at substantially reducing CO2 emissions and energy consumption in the city, with the technical and economic risk being assumed by the future Energy Service Companies (ESCOs), which are expected to undertake the necessary investments, sharing the savings generated with the City Council. This activity also provided realization of an essential and tangible part of Santander Smart City, which is one of the main lines of the city's strategy for future.

The UVAX solution integrates in one platform public lighting management, control, regulation and all Smart City solutions using the electric power network, providing following advantages:

- Open and scalable system;
- In line with B-PLC (Broadband Power Line Communication) using the existing wiring infrastructure;
- “Point to point” control of public lighting system and additional services;
- Increased efficiency leading up to 70% of cost savings.

Seville, Spain

Solar public lighting system providing public safety in remote areas

Case study:
Smart public lighting

Industry:
Local authorities

Executive summary

Solar lamps are private or public lighting elements with the advantage of autonomy and high cost-effectiveness. Solar lamps are powered by renewable energy, thus saving a large percentage of electricity which would otherwise be used. Moreover, as they are independent, they can be placed in remote locations.

The challenge:

Seville City Council is committed to tackling climate changes, working hard to meet the objectives of the Seville 2030 strategic plan, as well as the Sustainable Development Goals (SDGs).

As public lighting system in the city has high energy consumption, there is significant place for improvement by reducing energy expenditure and at the same time maintain efficient use of public space.

During the modernization process of public lighting system was necessary, LED luminaires have been implemented in most of the city areas, however, few zones required different lighting system.

At-a-glance

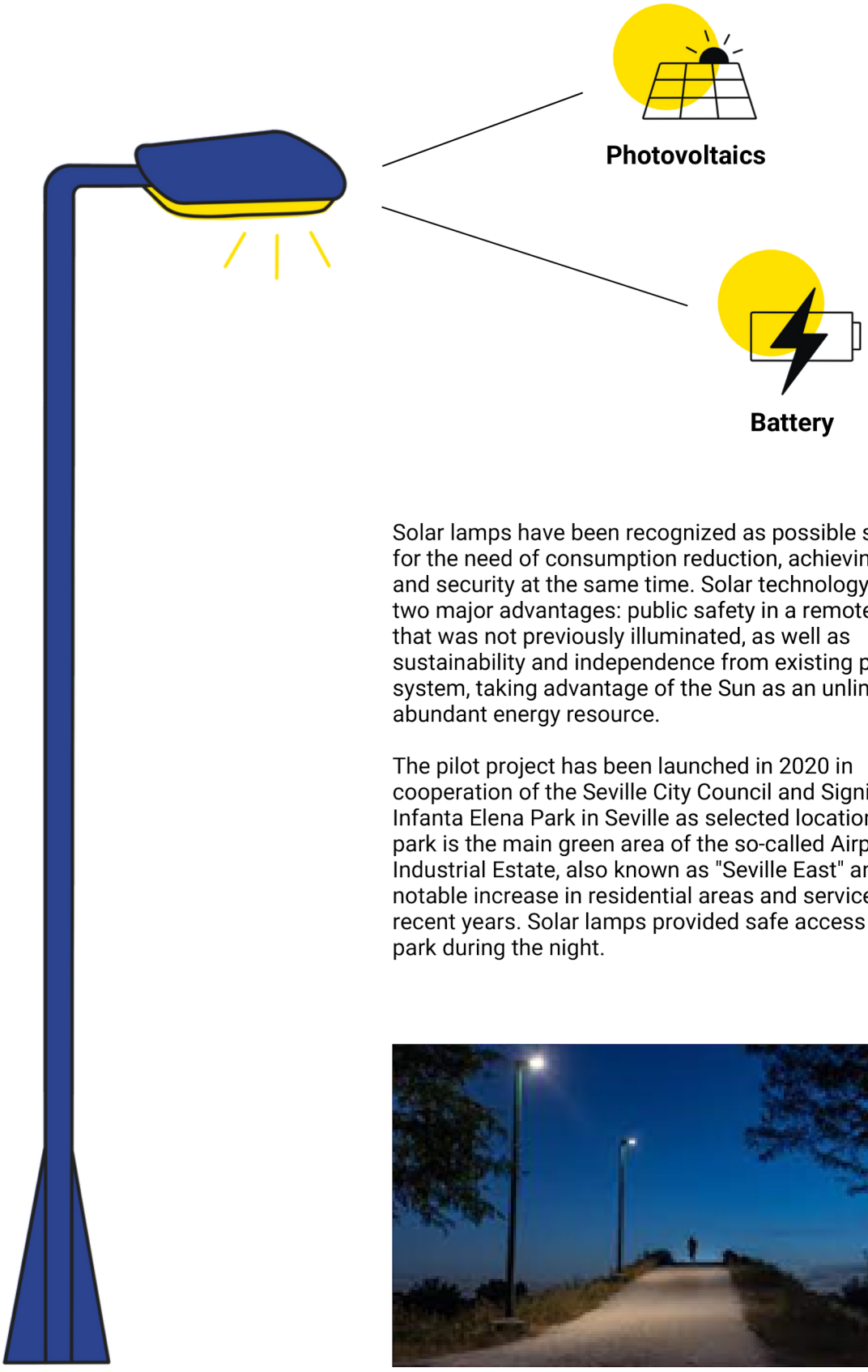
Goal:
• To upgrade the public lighting system, using the benefits of renewable (solar) energy.

Approach:
• To implement photovoltaic solar lighting, starting with 20 pilot lighting points;
• Using the benefits of location in the south of Europe with big insolation.

Results:
• No need for additional electricity consumption;
• No energy costs.

Featured solutions:
• Philips SunStay solar lamps, each integrating a solar panel, luminaire, charge controller and battery in one lamp post - 20 solar units in 2020;
• The investments in the acquisition of the lamps and maintenance of the town hall provided by the City.

The solution:



Solar lamps have been recognized as possible solution for the need of consumption reduction, achieving lighting and security at the same time. Solar technology offers two major advantages: public safety in a remote space that was not previously illuminated, as well as sustainability and independence from existing power system, taking advantage of the Sun as an unlimited and abundant energy resource.

The pilot project has been launched in 2020 in cooperation of the Seville City Council and Signify in Infanta Elena Park in Seville as selected location. This park is the main green area of the so-called Airport Industrial Estate, also known as "Seville East" and with a notable increase in residential areas and services in recent years. Solar lamps provided safe access to the park during the night.

Nuevo Baztán, Spain

Solar LED public lighting as simple and effective solution for rock-ground areas

Case study:
Smart public lighting

Industry:
Local authorities

Executive summary

The Nuevo Baztán Municipality Council is making a firm commitment to sustainability using renewable energy in its public lighting LED type system powered by solar panels and high-performance batteries. The main advantage of this system is its ease of installation and zero energy consumption.

The challenge:

Nuevo Baztán is a Spanish municipality belonging to the Community of Madrid, located 50 km east of Madrid, with population of 6 760 inhabitants on 20,2 km².

The existing public lighting system was in a poor condition including the bad insulation of cables, the old cabinets and lamps of small stature together with rusty and insufficient luminaires to achieve the minimum lighting standards. There was an urgent need for undertaking measures such as completely new installation, making trenches, installing tubes, putting new light points with their lamp posts, new foundations, replacement of sidewalks and roads. The main challenge for the works turned to be the ground mostly composed of rock.

On the other hand, there was a need to expand the public lighting system to green areas by installing additional luminaries in parks and gardens, prioritizing those with more night traffic. In this way, the public safety of these areas will be increased.

To address these challenges, the use of solar LED public lighting was proposed. After an initial period of observation and testing the performance of the first facilities, the residential area of Las Villas has been selected as a pilot, for modernization of 290 lamp posts.

At-a-glance

Goal:
• Modernization of public lighting system installation with the aim of energy savings on the municipality level, economic savings on public lighting installation costs.

Approach:
• To implement innovative system, easy to install (without difficulties during set up such as rock drilling) and with high cost-effectiveness regarding deployment and maintenance.

Results:
• Energy, CO2 emissions and economic savings (40% due to installation and maintenance, 100% due to energy bills thanks to renewable energy use);
• Avoiding light pollution.

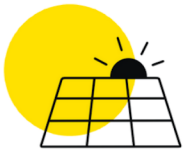
Featured solutions:
• 290 high-efficient LED luminaires with single consumption of 40 W and Flux of 3000 Lm, on 6 m high lam posts,
• High-capacity photovoltaic panel (60 Wp);
• Lithium iron phosphate battery with an estimated life of 2000 complete charge and discharge cycles and an admitted depth of discharge of 90% without affecting battery life (30 Ah battery at 12.8 V);
• MPPT (maximum power point tracker) charge controller that always provides maximum charging power for the battery;
• Possibility of controlling the behavior of the luminaire and changing its dimming profile through a Bluetooth connection and through an app,
• Presence sensor.

The solution:

All in one luminaire in public park

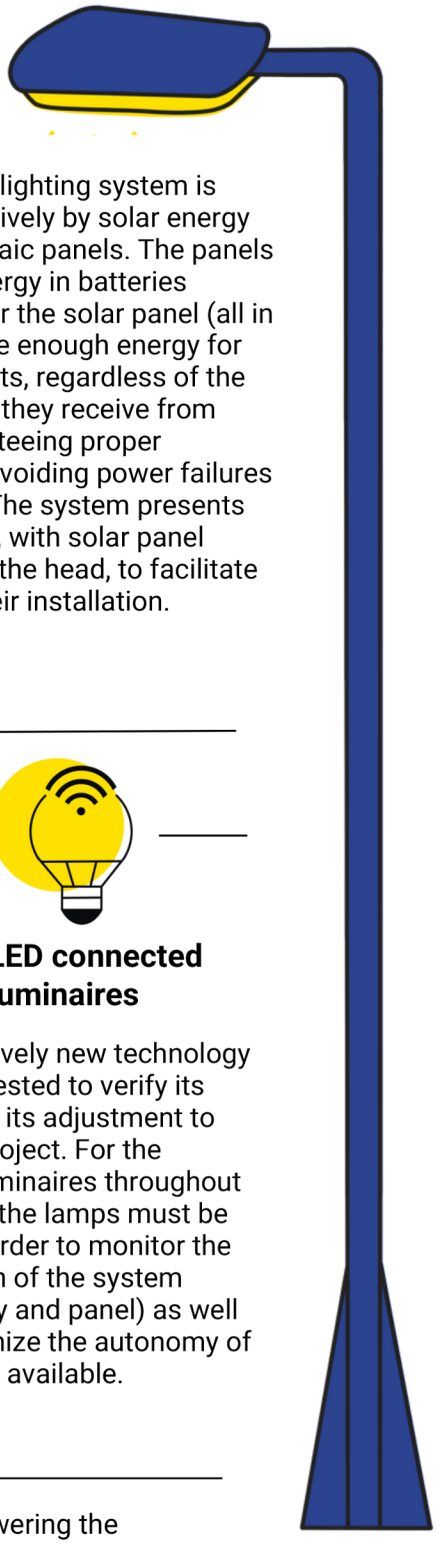
All in two luminaire in residential zone

Luminaires by night



Photovoltaics

Battery



The new public lighting system is powered exclusively by solar energy using photovoltaic panels. The panels accumulate energy in batteries integrated under the solar panel (all in 2) which provide enough energy for four winter nights, regardless of the amount of light they receive from outside, guaranteeing proper operation and avoiding power failures in the system. The system presents all-in-one mode, with solar panel integrated with the head, to facilitate and simplify their installation.

Cloud-based control & management

LED connected luminaires

Solar LED lighting is a relatively new technology that has to be sufficiently tested to verify its proper implementation and its adjustment to the specific needs of the project. For the correct autonomy of the luminaires throughout the night, the load curve of the lamps must be adjusted appropriately. In order to monitor the behavior and status of each of the system elements (luminaire, battery and panel) as well as control in order to optimize the autonomy of the system, a mobile app is available.

Presence sensor

The system provides constant lighting, lowering the lighting level based on the scheduled time and providing a higher lighting level when detecting presence within a radius of 25 meters. In this way, light pollution is reduced and considerable energy savings are enabled.

Haute-Savoie, France

Interoperable centralised lighting management system

Case study:
Smart public lighting

Industry:
Local authorities

Executive summary

Initially responsible for the development of electricity networks in rural areas, Syane is now an operational energy and digital player in Haute-Savoie (France), serving the region's energy and ecological transition. Every day a new smart city project is announced: public lighting system becomes connected to save energy and increase the quality of lighting services in the streets; waste containers are being monitored to reduce truck traffic whilst helping cities to get cleaner; free parking spaces are detected and advertised to drivers both to reduce pollution and to allow variable pricing depending on their availability; and more.

The challenge:

Most of the available smart city solutions today are proprietary, locking cities into single vendor solutions. Syane will implement interoperable software for piloting, on the same platform, public lighting system (2 877 luminaires and 188 cabinets) and smart city sensors from different manufacturers.

At-a-glance

Goal:
• Using a central management system to control the public lighting system network;
• Deployment of lamp switching and dimming regimes according to the lighting standards and category of roads;
• Prevention of getting locked into single-vendor solutions.

Approach:
• To use one single central management software to control a heterogenous network combining various vendors' solutions.

Results:
• Energy savings,
• Public lighting service quality increase,
• Pollution reduction,
• Automatic identification of the failures.

Featured solutions:
• TALQ protocol for management software interfaces to configure, command, control and monitor heterogeneous outdoor device networks including smart public lighting system.

The solution:

Cloud-based control & management

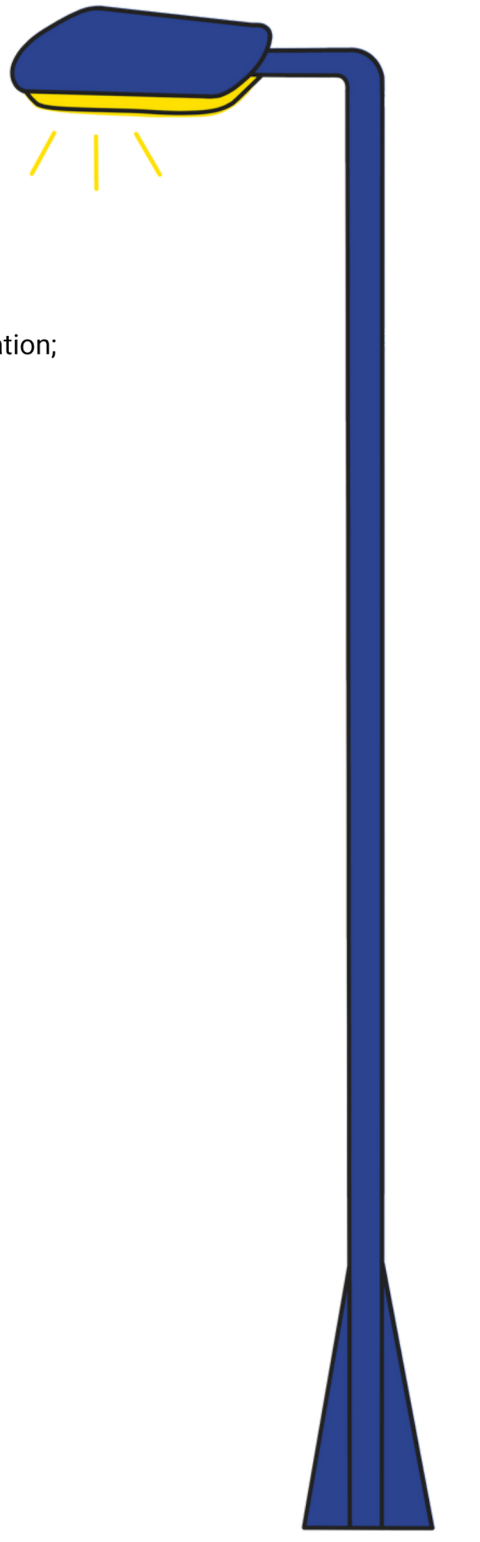
LED connected luminaires

Illuminance sensor

Internet of Things

Video surveillance

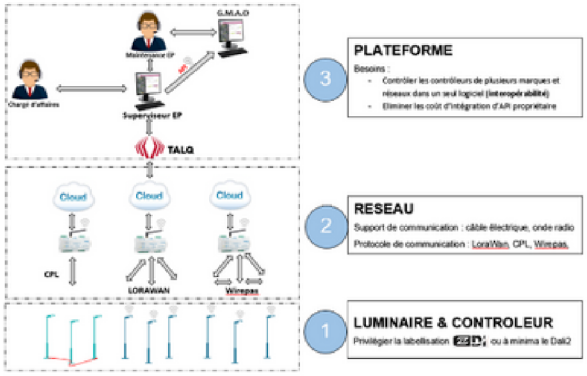
Parking sensor

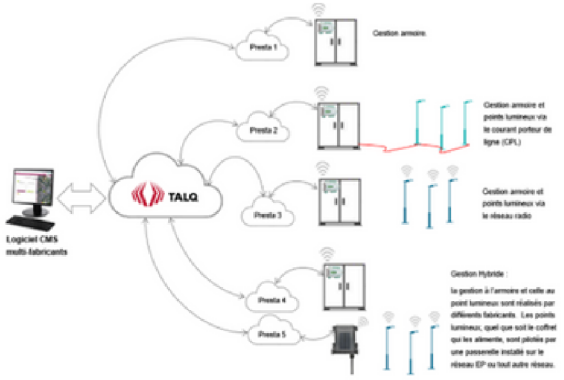


Syane will use a smart city standard (TALQ protocol) for management of software interfaces to configure, command, control and monitor heterogeneous outdoor device networks including smart public lighting system.

TALQ eases the introduction of networked Smart City Solutions with a large variety of benefits for cities such as:

- Multi-vendor choice;
- Open platform with OpenAPI Specification for accelerated innovation;
- Common language for different smart city applications;
- Increasing cost efficiency;
- Faster introduction of LED luminaires in road and urban lighting;
- Reducing energy consumption and CO2 emissions worldwide;
- Professionalisation of operations management;
- Cross-departmental cooperation.





Greater London, United Kingdom

Taking charge of safe and reliable EV charging infrastructure integrated in lampposts

Case study:
Smart City
EV charging

Industry:
Local authorities

Executive summary

With a key driver being the environmental benefits, electric vehicles (EV) are becoming pivotal parts of urban regeneration. Reducing emissions and improving the carbon footprint of both individuals and communities, EVs and their supporting infrastructure are now vital assets for cities throughout the world. Greater London area (including 32 London boroughs and the City of London) is took charge of safe and reliable on-street EV infrastructure in 2019 in collaboration with Ubitricity and Lucy Zodion.

The challenge:

The main challenge of the project was to support the transition of the use of the public lighting. From being solely used to illuminate public areas, it is now required to become a multipurpose piece of street furniture, providing both illumination and infrastructure for EV charging simultaneously, while ensuring power and protection to both people and equipment, in-line with electrical regulations.

Not only the electrical safety within the public lighting lamppost is considered, but also the safety of the end-user while using EV charging point. The solution had to provide a separate feed to the luminaire to ensure continual operation in the event of electrical issues.

There are a number of initiatives throughout the UK that are helping to drive the uptake of EV. One of these initiatives is the 'Go Ultra-Low City Scheme' (GULCS) procurement framework, which has been set up by London Councils, TfL and the GLA, to ensure the Capital's transport network meets its aim to be the Ultra-Low Emission Vehicles (ULEV) capital of Europe.

The Scheme has four main streams of work which focus on making residential charging available, increasing the provision of fast chargers and increasing the provision of charging infrastructure in car club bays. This increased uptake refers to solutions required not only to make EV charging points more accessible, but also to ensure the supporting infrastructure is capable of providing a consistent, safe and reliable power supply.

Ubitricity is a market leading supplier of on-street EV charging solutions, integrating them within existing street furniture to make public EV charging available and simple to use. This EV charging specialist recently carried out work as part of the GULCS by transforming existing public lighting lampposts into on-street charging points, throughout the City of London and surrounding boroughs.
As the UK's market leader in the provision of connection equipment for public lighting system infrastructure, including the sole supply of public lighting cut-outs and isolators into the UKPN electrical network, Ubitricity selected Lucy Zodion as its solution partner for this project.

At-a-glance

Goal:
- Public lighting system infrastructure used for both illumination and infrastructure for EV charging;
- Safe and reliable public EV charging infrastructure;

Approach:
- Provide a certified and approved solution that works alongside existing public lighting system infrastructure;
- Meet all relevant industry standards, as well as those outlining the safety of users;
- Demonstrate a proven track record;
- Immediately available solution;

Results:
- Reduction of emissions and improving the carbon footprint;
- Electrical safety within the public lighting lamppost;
- Safety of the end-user while accessing EV charging;

Featured solutions:
- Ubitricity's charging equipment;
- Lucy Zodion Trojan Midi with 32A switch disconnector including several thousand secondary isolators to provide 32A supply protection and lockable isolation for public lighting lamppost. They provide 25A residual protection for the 5.8kW EV charging equipment, plus 6A protection for the luminaires to continue operating as normal in the event of a fault on the charging equipment;
- Appropriate protection of both the EV charging equipment and user from electric shock in line with industry standards;
- Separate feed to the luminaire to ensure continual operation.

The solution:

Lucy Zodion's isolation solution met all objectives successfully, resulting in a certified and approved installation. As a result of the project, various London Boroughs are closer to meeting their Ultra-Low Emissions targets with a capable infrastructure to support EV charging points.

Due to the number of units required, these were shipped weekly to support a wide-scale roll out over a relatively short period, which suitably matched the installation schedule.

The isolators provide 25A residual current and overload protection for Ubitricity's 5.8kW EV chargers, which are mounted into existing public lighting columns. In addition, 6A protection is included for the luminaires to provide dedicated supply and protection in order to minimize outages. The isolators were used in conjunction with the Network Operators (UKPN) approved Lucy Zodion Street Lighting Cut-Out.

Los Angeles, California, USA

Accelerating EV charging adoption inside the city's limits

Case study:
Smart City EV charging

Industry:
Local authorities

Executive summary

The Los Angeles Bureau of Street Lighting (LABSL) partnered with FLO, to make the most of the City's complex public lighting infrastructure featuring over 220,000 individual lighting poles. EV charging infrastructure was integrated into the existing public lighting system infrastructure to leverage the excess power resulting from public lighting system reconstruction. The project resulted in 3,699 charging sessions with average session duration of 2 hours and 23 mins and average monthly growth in users of 24%. Total energy transferred is 40,879 kWh.

The challenge:

A recent public lighting system upgrade resulting with its transition to LED technology resulted in excess available power inside the public lighting system infrastructure. As part of their commitment to foster EV adoption inside the City's limits, the City of Los Angeles aspired to using this excess power to integrate EV charging infrastructure into the existing public lighting system and combat "range anxiety", the phenomena which sees EV drivers concerned about their vehicle's charge being insufficient for their commuting needs.

In detailing their vision for the project, LABSL articulated a specific set of goals and a unique series of challenges. Early conversations with the utility revealed their intentions for the project to be threefold:

- First, to leverage the department's existing infrastructure (public lighting lampposts) for integration, thus reducing the overall costs and timeline for deployment;
- Second, to source robust and durable hardware capable of functioning in all the diverse neighborhoods of the City of Los Angeles;
- And finally, to deploy the charging stations in a way that would cover the largest geographical range while servicing the largest percentage of the EV driving community.

At-a-glance

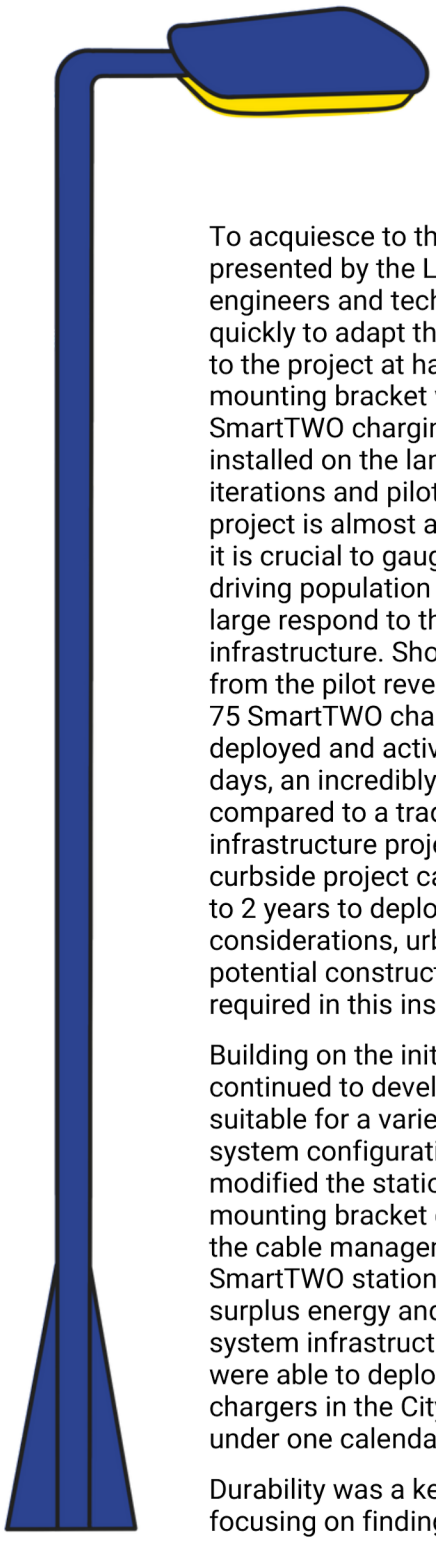
Goal:
- Leverage Existing Infrastructure;
- Condense Deployment Timeline;
- Achieve large geographical exposure;
- Foster EV Adoption;

Approach:
- Using excess power to integrate EV charging infrastructure into the existing public lighting system;
- Provide a certified and approved solution that works alongside existing public lighting system infrastructure;
- System durability;
- Quick deployment of EV charging infrastructure;

Results:
- Reduction of emissions and improving the carbon footprint;
- Reduction of both installation and energy costs;

Featured solutions:
- 324,000 EV drivers (964,000 by 2025);
- Station Models: SmartTWO.

The solution:



LED

EV charging infrastructure

Connection to existing power lines

To acquiesce to the specific challenges presented by the LABSL, FLO's team of engineers and technicians had to move quickly to adapt their existing technology to the project at hand. FLO developed a mounting bracket which allowed the SmartTWO charging stations to be installed on the lampposts, after several iterations and pilot installations. A pilot project is almost always recommended, as it is crucial to gauge how both the EV driving population and the population at large respond to this new EV charging infrastructure. Shortly after the analytics from the pilot revealed it to be a success, 75 SmartTWO charging stations were deployed and active in approximately 90 days, an incredibly condensed timeline as compared to a traditional curbside infrastructure project. A traditional curbside project can take anywhere from 1 to 2 years to deploy, mostly due to design considerations, urban planning and potential construction that was not required in this instance.

Building on the initial success, FLO continued to develop mounting brackets suitable for a variety of public lighting system configurations and further modified the stations via an auxiliary mounting bracket designed specifically for the cable management system of the SmartTWO station. By leveraging the City's surplus energy and existing public lighting system infrastructure, FLO and the LABSL were able to deploy the initial run of EV chargers in the City of Los Angeles in under one calendar year.

Durability was a key procurement factor, focusing on finding charging stations that would remain operable through extreme heat or potential vandalism. FLO's SmartTWO stations, constructed from aluminum and NEMA 3R certified turned out to be ideal for this deployment.

The modular or "hot swap" element of the SmartTWO station allows a repair technician to replace broken or malfunctioning components quickly and easily in as little as ten minutes. This modular technology assists greatly in maintaining a high station "uptime," a priority for both EV drivers and EV charging points owners.

Los Angeles is a sprawling metropolis covering over 1,300 square kilometers (500 miles), and it was imperative to the City that the SmartTWO deployment service the greatest number of potential EV drivers. After careful consideration and planning, the SmartTWO chargers were deployed in a manner that covered approximately 89% of the city's square kilometers and stretched across all fifteen counties in the city. Data insights from the now operational EV charging network in Los Angeles illustrate that the average distance travelled between stations is a mere 7.11 kilometers (4.42 miles), demonstrating an effective capacity to combat range anxiety; furthermore, the average charging session from these stations added approximately 50.05 kilometers (31.1 miles) of range to the EV charge, more than satisfying the needs of a commuter in Los Angeles, who travel on-average 20.76 kilometers to get to work.

Kazan, Russia

Piloting the lamppost integrated solution as a prerequisite for mass scale of 5G roll-out

Case study:
Smart City Communication technologies

Industry:
Communications service providers

Executive summary

The Lightpole 6730 site in Kazan (Russia), 17 meter in height, was completely installed in less than 8 hours due to its pre-assembly. Such an approach showed the high market potential due to Telco's operating model to leverage customer and application demands for high bandwidth, low latency and seamless connectivity.

The challenge:

As demand for broadband connectivity and high data speeds increases, communications service providers (CSP) are identifying creative ways to accelerate 5G rollouts while at the same time reducing the total cost of ownership. In urban environments in particular, delays in site acquisition cost and the general challenges of getting permits approved by local councils, as well as concerns regarding the aesthetic aspects of installations is adding up to a challenge.

With its low latency and high bandwidth, 5G will speed mobile video streaming, enhance online gaming experiences in virtual worlds and enhance sports and entertainment events.

A macro cell network alone can't provide the high-quality, always-on experience that mobile broadband customers will expect of 5G. Small cell radio base stations are needed to complement the macro network, especially In dense urban areas. An outdoor small cell can cover a sizeable outdoor area, as well as indoor users on lower floors of buildings.

While small cells are a vital tool for network operators, placing them in the urban areas where they're most needed can be a laborious and expensive process. Site acquisition typically takes 9 to 22 months; deployment can take another 6 to 12 months. Meanwhile, the requirements for camouflage are continuously increasing and the local permitting process can be difficult.

To address these challenges, Ericsson, along with Smart City solution provider Ubicquia and with support from AT&T, have partnered to introduce Ericsson Street Radio 4402.

At-a-glance

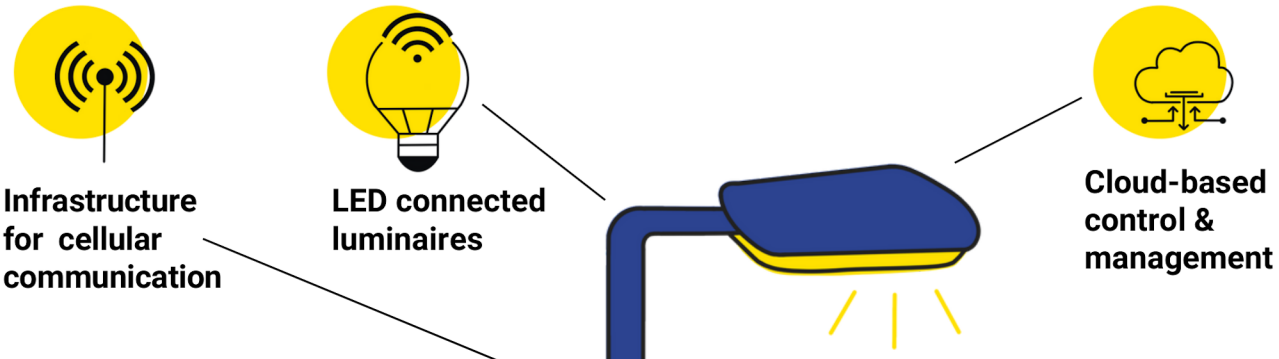
Goal:
- Innovative micro-site coverage via new type of infrastructure (lamppost integrated);

Approach:
- Fast and simple deployment
- Leverage existing smart lighting infrastructure;

Results:
- 5G user experience;
- Increased broadband connection points;
- Low power consumption ;
- Minimal ground footprint;
- Power grid available on site;

Featured solutions:
- Ericsson SW/HW equipment standardized according to 3GPP requirements;
- Lightpole 6730 is multi-technology product (2G,3G,4G/5G,IoT);
- ENM (Ericsson Network Manager) is used for data collection and management system across RAN nodes and other network parts;
- Ericsson remote site management gives all time visibility to the site equipment, remote site control and supervision, automated and simplified workflows and O&M control;
- Controller 6610 is the key component of the Ericsson RSM.

The solution:



Innovative micro-site coverage introduces new type of infrastructure (lamppost integrated solution) where the service offering depends on Telco Operator business strategy. The featured benefits of the lamppost integrated solution are:

- Enables site permits in difficult areas,
- Overcomes site acquisition issues; tailored to city infrastructure;
- Deploys in one day and reduces OPEX;
- Generates energy savings of 50%-70% through efficient LED lighting;
- Strengthens mobile broadband coverage in cities and seamless communication in dense areas inside the city;
- Supports all technologies as well as micro, macro; WiFi/camera/environmental sensors, fiber, antenna and MINI-LINK;
- Houses equipment both inside and under the lamppost.

Also, other versions of lamppost integrated solutions are tested in many networks like:

- San Jose, USA: deployment of 50 lampposts that comprise energy efficient LED lighting and Ericsson's fully integrated LTE. All sites are leased by the operator in agreement with Philips. Mass deployment of 200 lampposts is ongoing in San José and Los Angeles;
- Saudi Arabia: the world's first Lightpole site deployed in mid-2014, as part of a mass deployment in Saudi Arabia, providing prime connectivity for the citizens by using the most suitable and innovative infrastructure technology available;
- Thailand: a site installed with the purpose to solve the biggest congestion in a tourist hub. By modifying the standard design, Ericsson managed to create three cells in 180 degrees that also provide high capacity for a floating market on the other side of the area;
- Algeria: Mobilis and Ericsson partnered to deploy the first Lightpole site launched in downtown Algiers, to strengthen mobile broadband coverage in the city's dense areas.

Al-Wakrah, Qatar

Bringing fans to their feet with 5G services during Amir Cup Final

Case study:
Smart City Communication technologies

Industry:
Communication service providers

Executive summary

Ooredoo announced a new era of 5G opportunities demonstrating transformative, connected and digital 5G experiences with Ericsson at the 2019 Amir Cup Final and grand opening of the Al Janoub stadium, designed by world renowned architect, the late Zaha Hadid and built to host the 2022 tournament.

The challenge:

Ooredoo(Qatari telecommunication company) was given an assignment to leverage 5G technology to deliver an unforgettable experience for fans attending the 2019 Amir Cup Final match.

As Qatar gears up to play host to the world's biggest sporting extravaganza, Ooredoo partnered with Ericsson to pilot innovative 5G solution during the Amir Football Cup final match. The solution needed to be integrated during the final phase of the stadium construction in a very limited timeframe.

Ericsson installed 5G technologies that built upon the current Ooredoo 4G network to reveal a new range of capabilities for customers and offered a projection of how their lifestyles will be improved with the next generation of connectivity.

At-a-glance

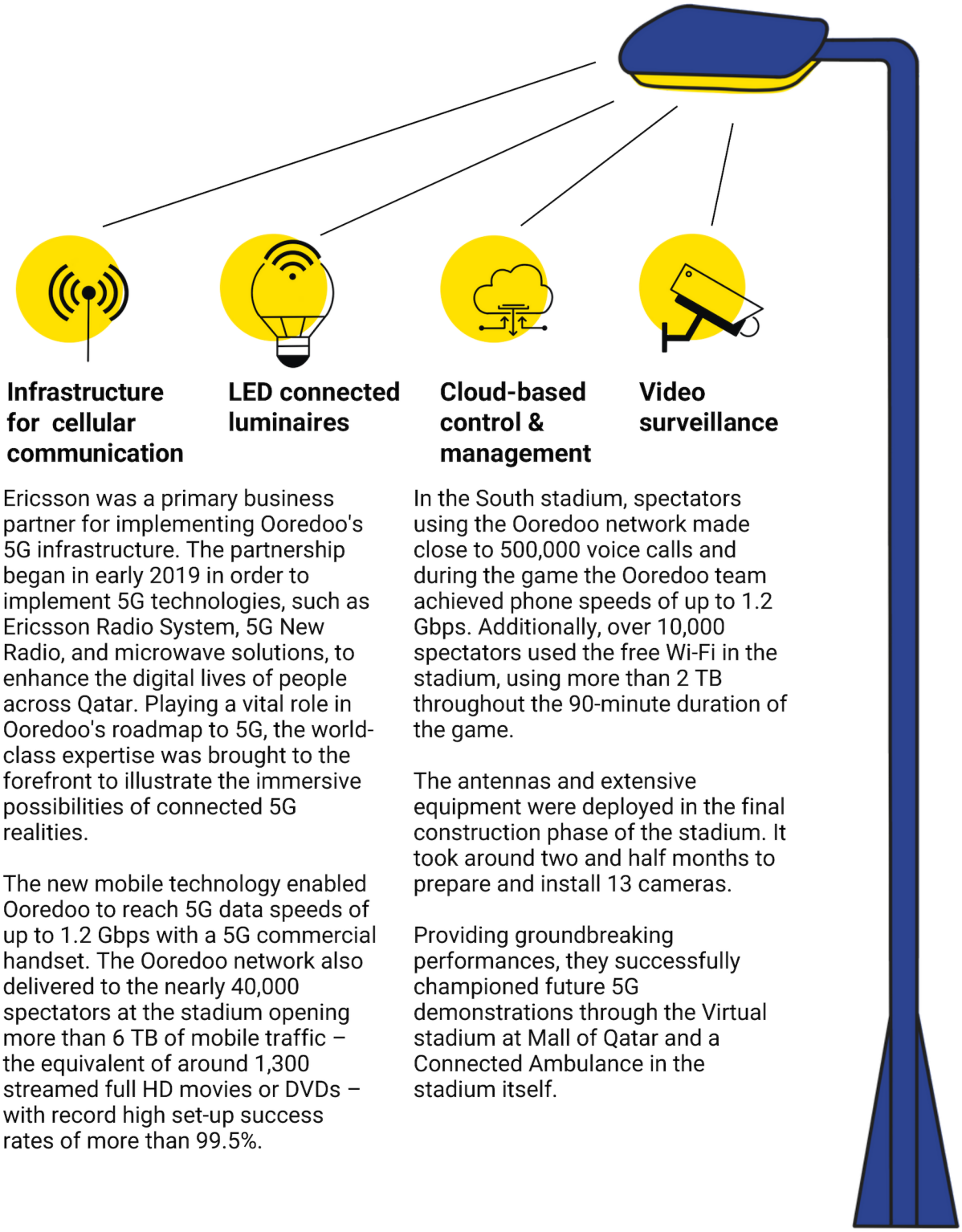
Goal:
- Deliver transformative network innovations to stay ahead of the curve and at the top of the local market;

Approach:
- Fast and simple deployment;
- Leverage existing smart lighting infrastructure;

Results:
- 5G user experience;
- Increased broadband connection points;
- Low power consumption for sustainability goals;

Featured solutions:
- Elastic Cloud Radio Technology including micro Radio 2203 and 2205 solutions, along with the Baseband 6502;
- Antenna with High Order Massive-MIMO.

The solution:



Infrastructure for cellular communication

LED connected luminaires

Cloud-based control & management

Video surveillance

Ericsson was a primary business partner for implementing Ooredoo's 5G infrastructure. The partnership began in early 2019 in order to implement 5G technologies, such as Ericsson Radio System, 5G New Radio, and microwave solutions, to enhance the digital lives of people across Qatar. Playing a vital role in Ooredoo's roadmap to 5G, the world-class expertise was brought to the forefront to illustrate the immersive possibilities of connected 5G realities.

The new mobile technology enabled Ooredoo to reach 5G data speeds of up to 1.2 Gbps with a 5G commercial handset. The Ooredoo network also delivered to the nearly 40,000 spectators at the stadium opening more than 6 TB of mobile traffic – the equivalent of around 1,300 streamed full HD movies or DVDs – with record high set-up success rates of more than 99.5%.

In the South stadium, spectators using the Ooredoo network made close to 500,000 voice calls and during the game the Ooredoo team achieved phone speeds of up to 1.2 Gbps. Additionally, over 10,000 spectators used the free Wi-Fi in the stadium, using more than 2 TB throughout the 90-minute duration of the game.

The antennas and extensive equipment were deployed in the final construction phase of the stadium. It took around two and half months to prepare and install 13 cameras.

Providing groundbreaking performances, they successfully championed future 5G demonstrations through the Virtual stadium at Mall of Qatar and a Connected Ambulance in the stadium itself.

Conclusion

Through the case studies presented in this paper, pilot projects across various cities demonstrate the successful implementation of different services that Smart EPC project focus on into public lighting system infrastructure. From Smart City applications to commercial energy services and non-energy services, these examples showcase the adaptability and efficacy of the integrated approach.

Public lighting systems, often underappreciated in their potential, embody the characteristics ideal for EPC interventions. Recognising the challenges faced by modern cities, including the imperative for energy balance, environmental sustainability, robust communication services, effective city management, citizen well-being and global city branding, the upgrade of public lighting systems with LED connected luminaires stands out as a key solution. The concept of Smart EPC extends beyond mere illumination. It envisions a comprehensive integration of additional services, such as environmental monitoring, EV charging solutions and communication technologies, into the existing smart public lighting infrastructure. This holistic approach transforms lampposts into multifunctional hubs that cater to diverse urban needs.

The benefits derived from this approach are vast. Street-side 5G solutions leverage the existing lighting infrastructure, ensuring a seamless 5G experience with minimal visual impact, increased broadband connection points and low power consumption. Environmental monitoring, facilitated by sensors on lampposts, enhances city life quality, generates pollution heat maps and contributes to sustainability goals. The integration of EV charging points into public lighting infrastructure not only supports sustainable mobility but also opens avenues for new revenue streams. Challenges persist, demanding thoughtful consideration in securing power infrastructure, deploying additional infrastructure efficiently and ensuring non-intrusive installations. The complexity of implementing diverse services requires adherence to regulations, legal frameworks and careful planning. In conclusion, Smart EPC for public lighting systems transcends conventional boundaries, offering a blueprint for urban evolution.

By harnessing the potential of existing infrastructure, cities can not only address current challenges but also position themselves competitively on the global stage, fostering citizen well-being and environmental sustainability. As technology continues to advance, Smart EPC stands as a beacon, guiding cities toward a brighter, more connected and sustainable future.