Smart Street Lighting

DETAILS

SECTOR | Transport and Energy

STAGE | Operations and Maintenance

TECHNOLOGIES | Sensors, LED, Digital Signage, CCTV, EV Charging

SUMMARY

Street lighting has been developed to undertake much more than simply lighting urban and suburban areas. It can now be integrated into a wider management platform for collecting and processing smart city sensors' data related to transport, energy and city management, safety and security. Smart street lighting adapts the lighting in an area to the traffic and light conditions. For example at darker times it can use sensors to detect cars/cyclists/pedestrians and adapt the light level along their trip. By strategically approaching the implementation of this technology, service providers and governments could increase the safety of urban areas and neighbourhoods, improve the efficiency and quality of services, and enable greater sustainability in energy use. Smart Street Lighting Infrastructure and sensors can also be combined with communication technology, digital signage, CCTV, speakers and electric vehicle charging (*see also the Electric Vehicle Charging Use Case*).

As Smart Connected Cities[1] grow and develop globally (with climate action and safety initiatives being push forward), new methods for information collection, safety monitoring, and renewable energy use are of great value. The primary benefits of Smart Street Lighting are to provide lighting adapted to the movements in a city while having a bird's eye view of the surroundings, connecting streetlights across a city or region. They provide an optimised lighting services, according to movements and traffic, using electricity more efficiently and collecting data to be used to improve transport networks and traffic safety. The use of LED bulbs with built-in sensors allowing for detection of approaching or departing vehicles and pedestrians, helps enable this.

With the global population continuing to grow at 1.1% per year[2] and migrating to urban centres, smarter land and resource use is becoming a significant area of research. Information collection through innovative technologies such as Smart Street Lighting are important sources of data and insights for Smart Cities to improve asset management and service efficiency.

Potential ancillary components of Smart Street Lighting include dynamic information signage and sense marketing for mood calming. Dynamic information signage linked to sensor technology could be used to display areas of congestion, travel delays or nearby hazards (*See also the Real-time Traffic Management use case*).

The idea of sense marketing has been used in retail outlets throughout the world, with certain smells, sounds and light effects encouraging users to purchase their products. The concept of mood calming through senses has been explored in underground stations in France and in Japan. There is potential for these ideas to be

[1] Defined as cities utilising connected technologies to communicate and process data to manage more efficiently the city services

[2] "World Population Prospects 2017", United Nations, Accessed 6 May 2020.

implemented within the Smart Street Lighting to enable better demand management as well as safety management, for instance playing music and changing the lights to improve the perception of nightlife, using scents (designed for outdoor or city spaces) to improve ambience, and soundscapes to notify users of public transport vehicles approaching and departing.

VALUE CREATED

Improving efficiency and reducing costs:

- Reduce energy usage through dimming when motion isn't detected. Can reduce energy usage further when couple with lighting technology such as LEDs: LED lights require less energy and can reduce lighting bills by 50-70%[3]. LEDs can last for 15-20 years therefore saving time and money for bulb replacement colours during events or becoming brighter when there is a safety concern).
- Enhance road lighting by improving road conditions and safety
- Reduce the costs related to road accidents

Enhancing economic, social and environmental value:

- Improve lighting around events and busy shopping or dining areas at night, encouraging increased economic activity late in the night
- Improve public safety and security through better lighting as well as CCTV and other sensor technology use
- Improve energy efficiency (as mentioned above) resulting in lower energy demand, lower electricity generation and more a sustainable use of resources
- Utilize technology for visibility and communication (change of lights, speakers for music, alerts and announcements) to improve the quality and safety of the urban space
- Ensure a satisfactory return on investment by utilizing the collected data to accurately inform network changes and decision making

POLICY TOOLS AND LEVERS

Legislation and regulation: The maintenance of Smart Street Lighting posts, as well as safety check-ups should be discussed and planned by governments, to ensure that standards are met. Furthermore, data collection – how it's stored, who it's available to and how it's formatted for research purposes – should be determined, to ensure user and public security and acceptance of the technology. The implementation of added technologies including EV charging and available hotspots, requires the government to consider and answer the following questions: Will use of these features be free of charge? If so, who will pay for the electricity and WIFI? Will there be a cap on the time to charge or use the hotspot?

Effective institutions: As is the case with implementing new technology, the government needs to develop a business case to quantify the benefits and justify capital expenditure of upgrading to Smart Street Lighting, amend regulations surrounding variable service delivery, and develop standards and specifications. These standards include smart street lighting metering, and general smart street lighting and luminaire/pole specifications. Other areas for government and stakeholder review include the transformation of and integration into existing electricity grids and other relevant infrastructure assets, and determining how to pay for the street lighting infrastructure upgrades.

Transition of workforce capabilities: New technologies and remote asset maintenance systems of the smart street lighting require the operations and maintenance workforce to be trained and follow specific maintenance activities and procedures. Government and relevant authorities should be in a position to have the right tools to monitor the expected outcomes and performances of the solution.

[3] "Lighting the road to smart cities and sustainability", Tomorrow Mag, Accessed 15 May 2020.

IMPLEMENTATION

Ease of Implementation 	Smart Street lighting relies on the implementation of the relevant lighting technologies and communications systems. These systems exist and are easy to implement but require appropriate planning to ensure effective implementation and use.
Cost 	The management systems for Smart Street Lighting do not represent high cost to implement and maintain. The main sources of cost are in the assets' (lights and communications devices, as a minimum) implementation, operations and maintenance.
Country Readiness 	Advanced countries have already started implementing and operating such solutions. For example Copenhagen, Denmark, have already assessed the proven safety and traffic management benefits. Cloud solutions will be required that can cater to the data capacity required.
Technological Maturity 	Whilst the individual components of Smart Street Lighting are already developed and implemented, in retail for example, the type of sensors and their range of detection is specific to locations, and therefore needs to be strategically designed. An advantage of LED luminaires is that they include cabling and connectors capable of accommodating the connection of sensors and communication devices later.

RISKS AND MITIGATIONS

Implementation risk

Risk: The features of Smart Lighting (dimming LED, sensor, CCTV, EV charging etc) are mostly developed for use in other applications. With a large network of Smart Street Lighting, implementation, management and maintenance of these various features can be challenging.

Mitigation: Planning the use case and then the number and locations of implementation of the required assets, is essential. The roll-out of the required assets and the related construction works to implement them should also be clearly assessed and prepared along with failure responses and incident management. An individual metering and monitoring system should be applied to each post, to ensure accurate energy readings (for the LEDs) and notifications of technological malfunctions. Additionally, the processing and compiling of CCTV footage and sensor data needs to be tailored to the type of information and the aim of data collection.

Social risk

Risk: The safety and environmental components of Smart Street Lighting are recognised as beneficial for safety related concerns. The main concern relates to sensor and camera use, which users could perceive as a privacy threat.

Mitigation: Mitigating this risk requires promoting the advantages of the technology, specifically how it will improve safety, congestion, public transport services and the quality of the urban space as well as having the right controls in place around personal data.

Safety and (Cyber)security risk

Risk: Data privacy related to connected technologies such as street lighting will need to be anticipated as well.

Mitigation: Data protection regulations, safety responses and policies should be developed that are linked to the impact these technologies can have on traffic and people.

EXAMPLES

Example	Implementation	Cost	Timeframe
Barcelona Lighting Masterplan	The installation of 10,000 LED streetlamps with sensors enabling dimming, remote management and free WIFI across the city. Additional sensors collect data on air quality.	High costs to implement the backbone assets infrastructure; safety and operations benefits assessed. The improvements resulted in a 30% reduction in energy usage across the urban lighting system[4].	The first masterplan was published in 2012. By 2014, 1,1000 lampposts had been transitioned to LED.
Shanghai Smart Lighting	Streetlamps with touch screen, surveillance cameras, free WIFI, area traffic condition information etc.	High costs to implement the backbone assets infrastructure; safety and traffic management benefits assessed.	Proven benefits of the implementation.
Tilburg Smart Philips Streetlights	Provide light on demand according to sensor activity.	High costs to implement the backbone assets infrastructure; safety and operations benefits assessed.	Proven benefits of the implementation.

[4] "How Smart City Barcelona Brought the Internet of Things to Life", Laura Adler Harvard EDU, Accessed 15 May 2020.