

# Los Angeles, United States of America

## From pioneer to leader: deployment of smart LED-based municipal street lighting

Since 2009, the City of Los Angeles has retrofitted over 180,000 street lights with light emitting diodes (LEDs). A smart system connects all installed LED fixtures to improve management and monitoring of the public lighting network. This multi-purpose initiative has resulted in significant energy and network maintenance cost savings. It has also enhanced livability and safety at night, while contributing to tackle climate change by progressively reducing public lighting-related carbon dioxide (CO<sub>2</sub>) emissions in the city. This example illustrates how implementing LED retrofit projects, combined with the adoption of smart, inter-connected street lighting management systems, is part of the pathway to become a more sustainable and climate smart city.

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### Introduction

LED-based street lighting has turned from a “nice to have idea” into a “must do action”. Efforts of early movers and front runners such as the City of Los Angeles, which carried out the world’s largest LED street lighting retrofit, have led the way. Modern and more efficient lighting technologies, combined with smart systems, enable cities and local governments to achieve multiple benefits when delivering a critical service to the community. The ability to remotely monitor and manage the street lighting network helps to achieve valuable energy savings, reduce maintenance costs, and deliver higher quality services – benefitting the citizens, the local government, and the environment.

### Los Angeles in context

The City of Los Angeles in California is one of the global cities leading the way on sustainability. Street lighting is one of the municipal service areas where sustainability has been embedded in the approach.

The most populous city in the State of California, Los Angeles owns the second-largest municipal street lighting network in the United States, after New York City. Since the adoption of an ordinance to fund street lighting in 1935, Los Angeles’ public lighting network has grown to over 220,000 street lights spread over streets, roads, parks, and public and open spaces.

In the late 2000s, the City of Los Angeles noticed that running the municipal public lighting service with conventional street lights was expensive due to excessive electricity consumption, with huge negative environmental impacts that had to be addressed. In 2008, the Los Angeles network of public lighting consisted of 209,000 street lights, consumed approximately 197 gigawatt hours (GWh) of electricity, with the energy cost amounting to 15 million USD per year. Following that, the Bureau of Street Lighting, one of five Bureaus in the Department of Public Works at the City of Los Angeles, sought a comprehensive solution to address the challenges identified here.

The local government formally launched a major project in 2009, called the LED Street Lighting Energy and Efficiency Program (Green Streetlight Program) to retrofit the city’s street lights with energy-efficient LED fixtures as well as implement a remote monitoring system.



### Fact and figures

#### Population (2014)

3,928,864

#### Total area (2016)

1,302 km<sup>2</sup>

#### Measured results of LED Energy Efficiency Program (2017-2018):

Annual energy savings:

110.45 GWh/year

Annual CO<sub>2</sub> reduction:

65,358 MT/year

km<sup>2</sup>: square kilometers

GWh/year: GigaWatt hours per year

MT/year: Metric Tons of carbon dioxide (CO<sub>2</sub>) per year

In 2015, as the second phase of action, the City of Los Angeles started to retrofit the remaining street lights with LEDs, and to implement a connected street light project using a sophisticated remote lighting management system. This would increase the quality of service delivery, and enhance livability and safety within the city at night.

## **Description of activities**

### **First phase: LED retrofit project**

In the first planning phase, and aligned to the ambition to become a climate leader, the City of Los Angeles in early 2008 took the decision to stop the use of conventional street lights in its public lighting network and deploy more advanced luminaires technology.

After considering relevant fixture technologies, the Bureau selected LED technology over induction technology for its retrofit project, as a cost efficient solution with enhanced optical control of LED luminaires that would work well. In October 2008, the mayor of Los Angeles approved the five-year project to convert 140,000 fixtures to LEDs, allowing the Bureau to commence rollout using internal funding. The retrofit project was based on collaboration between the Los Angeles Bureau of Street Lighting, the Los Angeles Mayor's Office, the Los Angeles Department of Water & Power, and the Clinton Climate Initiative (CCI) Cities Program.

In November 2008 and through a RFI, the City notified prospective LED street light manufacturers and technology providers about a demonstration project where interested manufacturers were invited to send four fixtures –considering the suggested requirements by the City- for testing to the Bureau at no cost or at a significantly reduced cost. The three-month test run was conducted through installing received LED fixtures from different manufacturers side by side on consecutive residential city blocks. Based on assessed fixtures performance, measured illumination levels, and collected feedback on the newly installed LED fixtures from the area residents through the surveys, the City drafted the fixtures specifications for the first installation year, and selected manufacturers to buy the fixtures from.

Subsequently in February 2009, the City of Los Angeles formally launched the Green Streetlight Program. Over 140,000 street lights were replaced with highly efficient LED luminaires, drawing huge attention since this was the largest LED street lighting retrofit project ever planned. At the beginning of the project, LED luminaires primarily substituted high-pressure sodium vapor lights, followed by metal halide, mercury vapor, and also incandescent cobrahead fixtures at the later stages.

Due to the relatively rapid evolution of LED technology, the Bureau decided to reevaluate the LED luminaires market every six months, revising specifications based on the best available technology, and purchase equipment accordingly.

With a completion horizon of five years, the project was to be concluded in 2013. However successful completion was announced in June 2012, with 141,089 LED luminaires installed. The installation crews were able to speed up the process as they gained experience, becoming more familiar with the technology.

The installed luminaires met or exceeded previous illumination levels, followed advanced lighting standards, and reduced light pollution and sky glow throughout the city. Part of the project specific aims was to ensure all installed LED fixtures were Dark Sky friendly, both in terms of the illumination level and the design of the fixture.

Further, as part of the Green Streetlight Program, a remote monitoring system was deployed. The system was aimed at collecting and centrally reporting real-time performance data for each LED fixture to track equipment function and failures, and to synchronize the collected real-time data with the Bureau's maintenance work orders. Although the system was implemented and covered almost one third of installed LEDs at the end of the first phase, the Bureau identified the lack of Global Positioning System (GPS) capability as a shortcoming. Therefore, the Bureau started to look around for a more effective option to be able to provide higher quality analytics toward better remote monitoring and management of public lighting network.

### **Second phase: smart system for connected street lighting**

By early 2015, the City was able to remotely control about 50,000 of its 160,000 LED street lights through the installed remote monitoring system. A more coherent solution was needed to connect the rest of LED street lights.

The second phase, announced in April 2015, was aimed at retrofitting the remainder of street lights with LED fixtures and enabling the City to monitor and control all the LED street lights remotely through a sophisticated system. The City's public lighting command room needed the capability to turn individual lights on or off, dim lights, and adjust each LED luminaire,

to provide the needed level of illumination all over the city. Another priority was to be able to collect and analyze data from the LED luminaires to enhance the quality of service delivery.

Going through a meticulous analysis of existing systems and technologies provided by various manufacturers, the City chose a smart public lighting management platform designed by Signify (at the time, Philips Lighting) for its connected street lighting project.

This platform includes a backbone system and smart sensors (chips) attached to LED fixtures to connect them through a cellular network. From a security perspective, the platform is highly secure as the chips used have “banking-level encryption”. Moreover, the system operates over cellular networks instead of local area networks. This should normally help reduce the risk of hackers gaining access to the system and information.

From selection, the Bureau rolled out the platform in 2015, installing the chips on all non-networked LED lights. 15,000 chips were lodged in the fixtures in the same year. Although the currently installed chips were manufactured by Signify; the backbone technology is not exclusive, and allows the use of sensors from other manufacturers as well.

The new platform transmits data to the Bureau’s asset maintenance system, and provides information for staff to schedule work deployments and generate reports. Issues are reported immediately, e.g. when an individual light goes out. Moreover, the system measures precise kilowatt-hour usage for each fixture, creating a high-resolution picture of actual electricity consumption of all LED fixtures. This helps to obtain an accurate overview of energy savings in the public lighting network.

The other objective of launching the second phase of the project was to retrofit the remaining 80,000 street lights with LEDs. This was slightly more challenging, compared to the first phase, as the Bureau needed to retrofit 400 different styles of decorative fixture all around the city.

The second phase retrofit project is well underway, and the Bureau is on schedule to conclude it by 2021. By then Los Angeles is likely to be the only city in the world to have converted all the fixtures to LED.

Moreover, since 2016 and in line with its smart connected street lighting initiative, the Bureau has started to replace old poles with smart poles, as part of the smart city approach. Other smart sensors (such as noise sensor) can also be installed on these poles, generating revenue by renting them to mobile phone carriers which would also lead to improving network coverage for mobile phones throughout the city. Furthermore, the City has initiated a program to install Electric Vehicle (EV) charging stations attached to street lighting poles. Over 100 EV charging stations have been set up so far.



Image 1: An installation crew from the Bureau of Street Lighting

Source: Signify



## Overall impacts and achieved results

This two-phased, multi-purpose initiative has increased the quality of municipal street lighting services while reducing the levels of light pollution, energy consumption, GHG emissions, and municipal costs. The latter is associated with both energy use and network maintenance in Los Angeles.

Based on the positive comments and feedback by the citizens, different community groups, and the Police Department, the implementation of the project has transformed the night landscape of Los Angeles, making the city safer and more pedestrian friendly at nighttime. Also, the Dark Skies Association has acknowledged the reduction in sky glow, light pollution, and trespass at night, there in Los Angeles. Also the following results have been reported by the City:

- Replacement of over 140,000 street lights with LED luminaires in the first phase of the project, finished in 2012
- Surpassing the original goals of the project plan for annual energy saving and CO<sub>2</sub> emissions reduction upon completion of the first phase: achieving a reduction of 47,583 metric tons in annual public lighting-related CO<sub>2</sub> emissions compared to initial estimate of 40,500 metric tons, and cutting 63.15% of the network's yearly energy use in comparison with the original estimation of 35% reduction (based on the measurements taken in 2012)
- Increasing the share of LED luminaires in the Los Angeles public lighting network to over 80%, owing to the continuation of retrofit efforts by the City after the first phase, where the total number of street lights has also raised from 209,000 to above 220,000 in the meantime.

More recent statistics (2018) by the City of Los Angeles show that current annual CO<sub>2</sub> reduction amounts to 65,358 metric tons (equivalent of taking more than 10,000 cars off the road in the United States). The return of investment (ROI) of the LED Street Lighting Energy and Efficiency Program has also been successful. Prior to the project, the Bureau's annual electricity bill totaled approximately 15 million USD. The annual energy savings achieved through this initiative is now equal to 110.45 GWh, with an associated annual energy cost saving of 9,816,649 USD, excluding maintenance cost savings. In addition, the implementation of the initiative has also helped the City save over 2.5 million USD in public lighting network maintenance. The initial estimation of the plan for both annual energy and maintenance cost savings was 10 million USD.

## Replication

The pioneering spirit and continued leadership shown by the City of Los Angeles has led to national and international acclaim. Such a comprehensive approach to a LED Street Lighting Energy and Efficiency Program is a model for all cities around the globe.

Multiple benefits can be gained when replacing old, inefficient, polluting and high consuming street lighting, using smart management systems. These include drastically cutting energy consumption and energy costs, reducing maintenance costs, and effectively lowering CO<sub>2</sub> emissions in a city.

Every local government can engage in this space, not only to deliver better services to citizens and businesses, but also to be a climate leader that acts fast to benefit from such "low hanging fruit" that outlines a clear business case for action.



Image 2: Los Angeles streets after the public lighting retrofit

Source: Signify

## Cost and Finance

The full implementation of the first phase required an investment of 56.9 million USD. This was financed through internal resources and funds contributed from energy savings and utility rebates. A seven-year, 40 million USD loan at a rate of 5.25% was provided by Los Angeles department of Water and Power (LADWP) and from City Funds. This initial loan, however, was replaced by another loan of approximately 40 million USD, provided by Bank of America in 2013. The money was part of the bank's 500 million USD financing program, called green bond, to fund low-carbon and sustainable business projects.

Moreover, the Bureau was mandated to contribute 3.5 million USD directly from the Street Lighting Maintenance Assessment Fund over the implementation period of this phase. The remainder was covered by LADWP through energy rebate funds.

While the originally anticipated timeline for project payback was seven years, it came notably sooner due to additional energy savings, combined with the continued fall in the price of LED fixtures. The ability of the City to auction removed old street lighting units (as opposed to simply recycling them) also contributed.

For the second phase of the project, financing has been much simpler due to the City's successful experience in loan repayment for the first phase. In 2015, the City launched the second phase through its internal funding sources. However, two loans were later used to finance this phase from external resources: a loan of 26.4 million USD in 2016, and another loan of 39.3 million USD in 2017 were secured from the same bank. These will be paid back over the next 10 years through annual savings in electricity and maintenance costs [6].

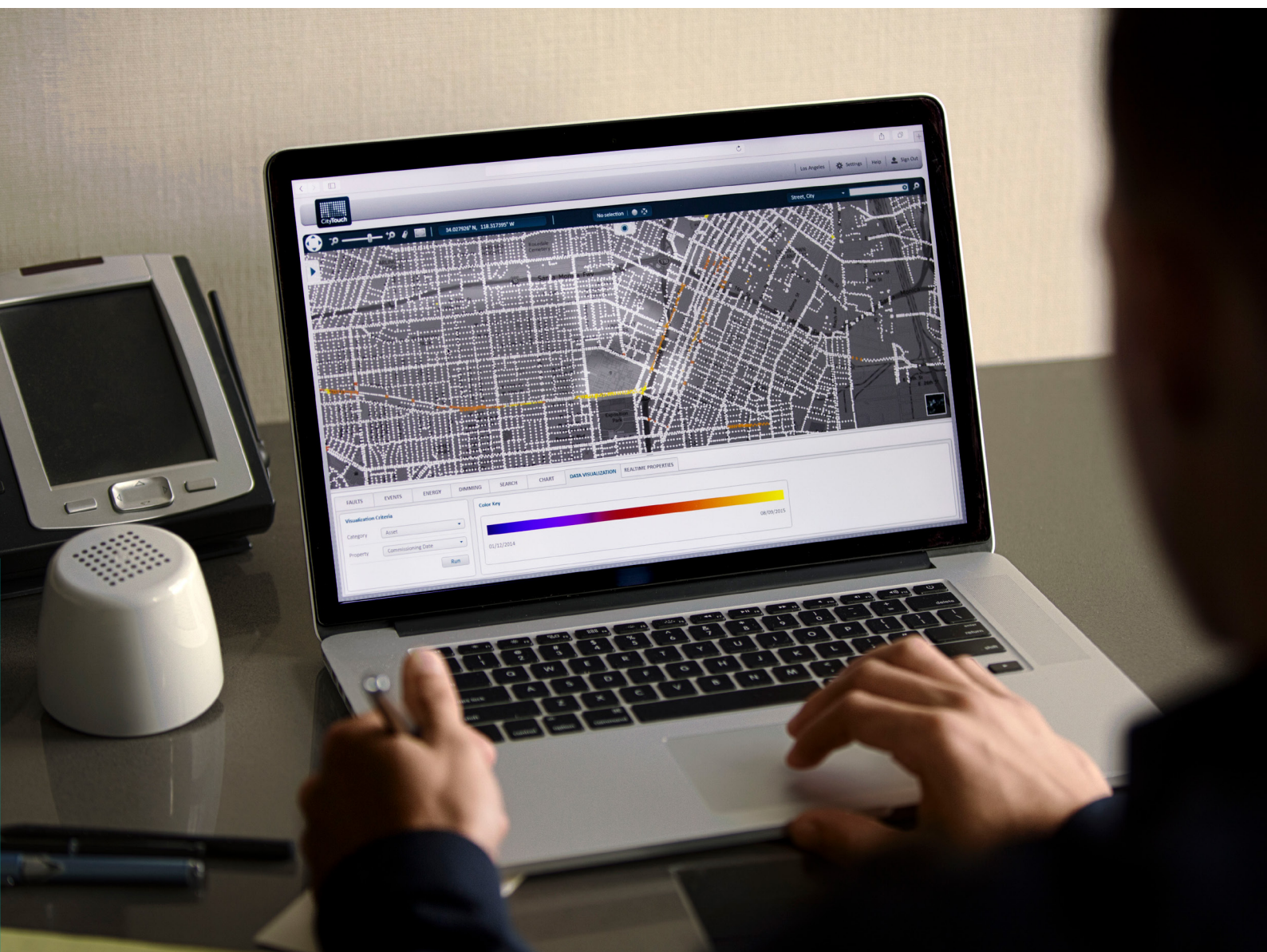


Image 3: CityTouch, a smart public lighting management platform

Source: Signify



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