Background

ISO 37120 & ISO 37122

ISO 37120, published in 2014, has quickly become the international reference point for sustainable cities. ISO 37120 is the first ISO standard ever published on cities. Led by experts at the University of Toronto who are now building the World Council on City Data, ISO 37120 was developed with cities worldwide since 2008. ISO 37120 defines a comprehensive set of 100 standardized indicators that enables any city, of any size, to assess their performance and measure progress over time and also draw comparative lessons from other cities.

Conversations with experts and city officials have identified the need for additional indicators for smart cities. WCCD experts are leading the development of a new ISO standard - ISO 37122: Indicators for Smart Cities within the ISO Technical Committee 268 on Sustainable Cities and Communities. This new standard builds on ISO 37120 indicators of city services and quality of life with a set of indicators to facilitate and promote the integration and interoperability of city systems to address efficiencies in service delivery while contributing to improving quality of life and enhancing sustainability. ISO 37122, Indicators for Smart Cities, will complement ISO 37120 and will help cities to implement Smart City policies to:

- Provide better services for citizens;
- Provide a better life environment where smart policies, practices and technology are put to the service of citizens;
- Achieve sustainability and environmental goals in a more efficient and innovative way;
- Identify the need for smart infrastructure;
- Facilitate innovation and growth, and
- Create a dynamic and innovative economy ready for the challenges of tomorrow.

About Signify

Signify (Euronext: LIGHT), formerly Philips Lighting, is the world leader in lighting for professionals and consumers and lighting for the Internet of Things. Our Philips products, Interact connected lighting systems and data-enabled services, deliver business value and transform the lives of people in homes, buildings and public spaces. With 2017 sales of EUR 7.0 billion, approximately 32,000 employees and a presence in over 70 countries, we unlock the extraordinary potential of light for brighter lives and a better world. News from Signify is located at the Newsroom, Twitter and LinkedIn page.
Cities globally are recognizing the value of high-caliber standardized city data to inform infrastructure investment and decision-making. This data-driven approach is particularly important for evaluating new smart infrastructure solutions, which can produce multiple financial, economic, social and environmental benefits.

One key opportunity area for cities is smart and connected public lighting. Of approximately 300 million streetlights across the world, only about 10% are high-efficiency LEDs, and just 2% are connected. Combining high-efficiency lighting with connected system management can deliver energy savings of up to 80%.

Two WCCD Foundation Cities – Los Angeles & Buenos Aires – have recently adopted integrated smart systems to manage their public lighting. These solutions were developed and implemented by WCCD Foundation Partner Signify. As this report shows, these types of solutions have immediate positive impacts that combine significant energy cost savings, reduced carbon emissions, improved system reliability, and reduced maintenance workload.

Improved lighting can also generate a wider set of benefits at the city level, such as reduced crime rates, improved citizen perceptions of safety, improved traffic safety for all road users, and significant contributions to city attractiveness and economic vitality. Quantifying many of these significant positive impacts from improved lighting at the city level is possible through WCCD ISO 37120 data. ISO 37120 defines a comprehensive set of 100 standardized indicators that enables any city, of any size, to assess their performance and measure progress over time and also draw comparative lessons from other cities.

This report presents a measurement framework that can monitor and evaluate city-level benefits from smart and connected lighting investments, through the unique opportunity afforded by WCCD ISO 37120 certified city data. These data can then play a major role in building the investment case for mobilizing funding and securing citizen support, demonstrating impact and progress over time, and assisting other cities to understand the benefits of these solutions through data-driven city-to-city learning.
Introduction

Infrastructure is critical to economic development, social welfare, public health, and quality of life, especially in cities. It also plays a fundamental role in determining how human activity impacts the environment and underpins the resilience of communities to disasters and extreme events.

Cities around the world often face complex and challenging choices concerning infrastructure, needing to maintain existing services while investing in improved services, managing population growth and enhancing sustainability – all within tight operating and capital budgets.

Public lighting is indicative of these challenges facing cities. The operation and maintenance of public and street lighting is typically a core responsibility of municipalities, representing a major cost for cities in terms of energy and maintenance and constituting a major component of a city’s direct GHG emissions.

However, new technologies and integrated solutions are transforming the way cities can deliver, operate and maintain their public lighting in ways that generate a range of significant benefits to city governments and the citizens they serve.
Smart Lighting: Reaping Major Economic, Environmental and Social Benefits for Cities

There is a range of possibilities for new technologies and smart connected solutions to improve lighting. Starting with the luminaire itself, conversion to new high-efficiency LED technologies has significant proven benefits. Lighting currently accounts for 15% of global electricity consumption, but with a universal switch to LEDs, lighting's share of power consumption would fall to just 8%, saving USD 290 billion and reducing global carbon dioxide emissions by about 1,400 megatons by 2030, with most of these benefits accruing in cities.

A further opportunity comes with connecting light points so that they can be monitored and managed remotely as part of an integrated system. When connected, street lights become edge devices that participate in the Internet of Things for cities. Connected lighting allows operators much greater control and oversight – such as programming and adjusting lighting levels for specific locations and detailed monitoring of energy usage per light point – as well as optimizing the overall performance of the system. Such connectivity also allows much more efficient maintenance planning and significantly reduces outages and downtime.

Combining high-efficiency LED lighting with connected system management can deliver energy savings of up to 80% for households, businesses and entire cities. Leading global examples of connected LED street lights are the Signify Interact city solutions described in Box 1.

Box 1 – Interact city in Los Angeles & Buenos Aires

Interact city, by Signify, is a leading example of the possibilities of smart lighting for cities and municipal governments. Interact city is a street lighting management system that integrates connected devices with web-based management applications, including:

- A remote lighting management tool for cities to measure, manage and monitor connected street lights remotely through a real-time, map-based view.
- A lighting asset management application supporting data visualization capabilities and lighting-related workflow management and maintenance planning.

Interact city has a suite of different connection nodes that can connect all street lights throughout a city, independent of vendor or luminaire type, avoiding vendor lock-in and maintaining future flexibility. Overall, Interact city provides city lighting managers with an integrated platform that helps make public lighting infrastructure much easier to analyze, plan and manage.

The Interact city solution is now being adopted by cities around the world, including Los Angeles and Buenos Aires – two Foundation Cities of the WCCD.

Los Angeles has a complex lighting system with 215,000 street lights that include 400 different styles distributed over 7,500 miles of roadway. Maintaining the system requires significant resources, requiring more than 70,000 streetlight repairs per year, with crews patrolling the street as well as responding to 40,000 outage calls from citizens.

The city is now one of the global leaders in conversion to LED lighting with 140,000 street lights converted to LED since 2009. The city has also adopted the Interact city solution with 110,000 nodes to be connected and managed through the Interact city System. Interact city offers the Bureau of Street Lighting remote monitoring, automatic notification of outages and other events, easy installation and commissioning, accurate lighting asset information, integration with the bureau’s existing management systems, and future proofing through software as a service delivery.

The City of Buenos Aires is another leader in smart lighting. The City entered into a public-private partnership with Signify, combining installation of energy-efficient LED luminaires with the Interact city management system. From 2013 to 2015, the partnership upgraded 9,600 light points or more than 75% of the public lighting in Buenos Aires.
Many cities are implementing smart lighting solutions because of the immediate benefits and attractive potential return on investment. Benefits include:

- Reduced energy costs
- Reduced maintenance effort and costs
- Improved operating budget position
- Reduced GHG emissions
- Improved system reliability

Box 2 highlights some of these benefits for Los Angeles and Buenos Aires.

Box 2 – Benefits of smart and connected lighting solutions – Examples from Los Angeles & Buenos Aires

Since 2013, Los Angeles has installed 140,000 LED street lights. Last year, the City reported energy savings of 63% and cost savings of nearly $9 million. The GHG emissions associated with public lighting have been reduced by 47,611 metric tons per year. With the CityTouch connected lighting system, the Bureau of Street Lighting no longer depends on routine patrols or citizen reports to identify outages, eliminating much of the on-site investigation and reducing response times from days to hours.

As part of the public-private partnership between the City of Buenos Aires and Signify, Interact city teamed up with SAP to help the City plan, budget and manage costs. The combined SAP and Signify solution links real-time information from Signify connected street lights with data from sensors in a single integrated city dashboard to help cities gather valuable information. As a result, Buenos Aires has been able to increase operational efficiency and realize energy savings of over 50%.
In helping to create tomorrow’s urban environment, public lighting delivers more than illumination. Lighting is essential for orientation and most importantly, for keeping cities and their citizens safe (and feeling safe too). It is a core enabler of economic vitality and can have a profound effect on the attractiveness of a city, which in turn supports investment and tourism. It also offers the flexibility and dynamism to become part of the expression of a city’s identity, emphasizing the character and diversity of areas within it. Measuring and assessing these wider benefits can be complex. However, there is a growing body of evidence of the positive impacts for cities of investing in improved public lighting services:

• Improved public safety/reduced crime rates. Improved lighting has been associated with reductions in crime rates. A major literature review showed that improved street lighting had a positive effect in reducing crimes such as burglary and theft. When all data are considered together, improved street lighting was associated with a relative reduction in crime of 21 percent in areas it was introduced, compared to similar areas where there were no such improvements. The City of Los Angeles observed a 10.5% drop in crime rates (vehicle theft, burglary/robbery/theft, and vandalism) in the first two years of its LED conversion program.

• Improved traffic/pedestrian safety. Street lighting also improves safety for drivers, riders, and pedestrians. Driving outside of daylight hours is more dangerous – only a quarter of all travel by car drivers is between the hours of 7pm and 8 am, yet this period accounts for 40% of fatal and serious injuries. Pedestrians and vulnerable road users particularly suffer from decreased visibility in the dark. A literature review of studies relating the presence of lighting to accident reduction concluded: “on urban main roads, with mainly a traffic function, a reduction in accidents involving injuries of approximately 30% can be expected at night following an improvement in the lighting from very bad to good”. More recent studies also associate improved lighting with reduced fatalities and severity of injuries.

• Economic benefits. Improved safety and perception of safety will have a positive impact on many local businesses as people become more willing to be out after dark. More broadly, improving overall lighting attractiveness of a city can support growth in tourism. These effects can further catalyze flagship public lighting projects that can attractors of tourism and economic activity in their own right. For example, an evaluation of the Bay Lights installation on the San Francisco–Oakland Bay Bridge estimated a total economic impact for San Francisco County of USD 18 million.

These benefits are greatly enhanced by new smart lighting solutions which improve the quality and reliability of lighting services and can be specifically tailored to deliver these outcomes: e.g. increased perceptions of safety and improved visibility for road users.
ISO THEME | BENEFITS | KEY ISO 37120 INDICATORS
--- | --- | ---
**Safety (Clause 14)** | Reduced crime rate (and improved perceptions of safety) | 14.1 Number of police officers per 100,000 population
14.2 Number of homicides per 100,000 population
14.3 Crimes against property per 100,000
14.4 Violent crime rate per 100,000 population

**Transportation (Clause 18)** | Improved road safety and increased willingness for commuting by walking or public transit | 18.3 Annual number of public transport trips per capita
18.5 Percentage of commuters using a travel mode other than a personal vehicle
18.8 Transportation fatalities per 100,000 population

**Environment (Clause 8)** | Reduced Office emissions | 8.2 Greenhouse gas emissions measured in tonnes per capita

**Economy (Clause 5)** | Enhanced economic vitality and investment attractiveness | 5.1 City’s unemployment rate as a percentage of total assessed value of all properties
5.4 Average household income in full-time employment
5.6 Number of businesses per 100,000 population

**Energy (Clause 7)** | Reduced municipal energy consumption | 7.2 Energy consumption of public buildings per year (kWh/m²)
7.5 Total electrical energy use per capita (kWh/year)

**Finance (Clause 9)** | Reduced operating costs for municipalities | 9.2 Debt service ratio (debt service expenditure as a percentage of a municipality’s own-source revenue)
9.3 Own-source revenue as a percentage of total revenues

**Recreation (Clause 13)** | Improved opportunities for outdoor recreation | 13.2 Square metres of public outdoor recreation space per capita

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**WCCD ISO 37120 Certified Data: Towards a Framework for Assessing City Impacts**

Cities globally are recognizing the value of high-caliber standardized city data to inform infrastructure investment and decision-making. Standardized city data can clearly quantify how investments improve infrastructure service levels across the city for citizens and businesses, and how these improved service levels can deliver benefits to the city as a whole. This data-driven approach is particularly important for evaluating new smart infrastructure solutions, which can produce multiple financial, economic, social, and environmental benefits.

WCCD ISO 37120 certified city data provide a framework for assessing the benefits of citywide investment in smart and sustainable lighting solutions, including many of the wider benefits described in the previous section. Table 1 lists some of the ISO 37120 indicators that could be applied in evaluating the longer-term impacts of smart lighting, considering these direct and wider benefits.

As WCCD Foundation Cities, Los Angeles and Buenos Aires have reported these ISO 37120 indicators as part of the WCCD ISO 37120 Certification (Table 2 and Table 3). These data can provide a baseline for examining the potential impacts of citywide smart and connected lighting solutions. With WCCD ISO 37120 data certified annually, there is an opportunity to monitor these parameters going forward to assess potential areas where the improved lighting is beginning to impact at the city level. Some benefits may be seen quickly, some may be gradual or cumulative over time, and in some instances it may be harder to isolate benefits solely associated with improved lighting.

The opportunity for using WCCD ISO 37120 data for monitoring impact over time is presented in Figure 1. The dividend for building this body of data is substantial. WCCD ISO 37120 certified data could play an important role in building the investment case for further investment in smart solutions and securing citizen support, demonstrating impact and progress over time, and facilitating other cities to understand the benefits of these solutions enabling rapid deployment and adoption locally and globally.

The WCCD is also playing a development of a new ISO standard - ISO 37122: Indicators for Smart Cities. This new standard builds on ISO 37120 indicators of city services and quality of life with a set of indicators to facilitate and promote the integration and interoperability of city systems to address efficiencies in service delivery while contributing to improving quality of life and enhancing sustainability. This new standard will provide an additional set of indicators to enhance the measurement framework presented in this section.
### TABLE 2 – WCCD ISO 37120 Certified Data: Los Angeles Baseline Data

<table>
<thead>
<tr>
<th>ISO 37120 INDICATORS</th>
<th>Los Angeles (2015)</th>
</tr>
</thead>
<tbody>
<tr>
<td>14.1 Number of police officers per 100,000 population</td>
<td>2,064/100,000/yr</td>
</tr>
<tr>
<td>14.2 Number of homicides per 100,000 population</td>
<td>6.67/100,000/yr</td>
</tr>
<tr>
<td>14.3 Crimes against property per 100,000 population</td>
<td>17.74/100,000/yr</td>
</tr>
<tr>
<td>14.4 Violent crime rate per 100,000 population</td>
<td>486.23/100,000/yr</td>
</tr>
<tr>
<td>14.5 Total number of public transport trips per capita</td>
<td>53.97/yr</td>
</tr>
<tr>
<td>18.3 Annual number of public transport trips per vehicle</td>
<td>27.3%</td>
</tr>
<tr>
<td>18.8 Transportation fatalities per 100,000 population</td>
<td>2/100,000/yr</td>
</tr>
<tr>
<td>8.3 Greenhouse gas emissions measured in tonnes per capita</td>
<td>13.39 t/capita</td>
</tr>
<tr>
<td>5.1 City’s unemployment rate</td>
<td>7.7%</td>
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<tr>
<td>5.2 Assessed value of commercial and industrial properties as a percentage of total assessed value of all properties</td>
<td>21.8%</td>
</tr>
<tr>
<td>5.3 Percentage of persons in full-time employment</td>
<td>15.7%</td>
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<tr>
<td>5.4 Number of businesses per 100,000 population</td>
<td>2,108.26/100,000</td>
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<tr>
<td>7.3 Energy consumption of public buildings per person (kWh/m²/year)</td>
<td>6,492.74 kWh/yr/capita</td>
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<td>9.1 Debt service ratio (debt service expenditure as a percentage of a municipality’s own-source revenue)</td>
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<tr>
<td>9.2 Square metres of public outdoor recreation space per capita</td>
<td>37.62 m²/capita</td>
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</tbody>
</table>

### TABLE 3 – WCCD ISO 37120 Certified Data: Buenos Aires Baseline Data

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<tr>
<td>SAFETY</td>
<td>■ Crimes against property per 100,000 population ■ Violent crime rate per 100,000 population ■ Number of homicides per 100,000 population ■ Number of police officers</td>
</tr>
<tr>
<td>--------</td>
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<tr>
<td>TRANSPORTATION</td>
<td>■ Transportation fatalities per 100,000 population ■ Annual number of public transport trips per capita ■ Percentage of non-motorised travel made other than a personal vehicle</td>
</tr>
<tr>
<td>ENVIRONMENT</td>
<td>■ Greenhouse gas emissions measured in tonnes per capita</td>
</tr>
<tr>
<td>ECONOMY</td>
<td>■ Number of businesses per 100,000 population ■ Assessed value of commercial and industrial properties as a percentage of total assessed value of all properties ■ Unemployment rate ■ Percentage of persons in full-time employment</td>
</tr>
<tr>
<td>FINANCE</td>
<td>■ Own-source revenue as a percentage of total revenues ■ Debt service ratio (debt service expenditure as a percentage of a municipality’s own-source revenue)</td>
</tr>
<tr>
<td>RECREATION</td>
<td>■ Square metres of public outdoor recreation space per capita</td>
</tr>
</tbody>
</table>

**Time of Initial Investment**

**Year 5**

**Year 10**

**Figure 1 – Tracking the impact of infrastructure investment over time using WCCD ISO 37120 Data**
Conclusions

There is enormous untapped potential for the deployment of smart and sustainable lighting solutions. Of approximately 300 million streetlights across the world, only about 10% are LEDs and just 2% are connected. Given the payback from reduced energy usage alone, there is a clear case for cities to consider adopting these solutions. When other benefits are added in – reduced crime, reduced traffic accidents and fatalities, catalyzed attractiveness, and economic activity – a city’s transition to energy-efficient connected lighting can become even more compelling.

With leading cities now deploying solutions and quantifying benefits, there is a growing evidence base to support these investment decisions. This report proposes a measurement framework which cities can use to monitor and evaluate potential city-level benefits from smart and connected lighting investments through the unique opportunity afforded by WCCD ISO 37120 certified city data. Through globally comparable city data, the network of WCCD ISO 37120 certified cities also provides the platform for data-driven city-to-city learning so all cities can better understand how investing in improved lighting could benefit their city and citizens.

→ dataforcities.org
References

8. ROSPA (2015)