CASE STUDY OF INNOVATIVE AND SUCCESSFUL BUSINESS MODELS THAT ENABLE LATIN AMERICAN AND CARIBBEAN CITIES TO ADOPT EFFICIENT TECHNOLOGIES IN STREET LIGHTING

BARILOCHE FOUNDATION

Executive Summary

October 2nd, 2018

ABBREVIATIONS

ACBA	Autonomous City of Buenos Aires
CC	Climate change
CDMX	Mexico City
EE	Energy efficiency
ESCO	Energy Services Companies
GEF	Global Environment Facility
GHG	Greenhouse gases
IDB	Inter-American Development Bank
LAC	Latin America and the Caribbean
PPP	Public–Private Partnerships
SL	Street lighting

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BACKGROUND INFORMATION

The project “Mechanisms and networks of technology transfer related to climate change in Latin America and the Caribbean,” prepared by the Inter-American Development Bank (IDB), was approved by the Council of the Global Environment Facility (GEF) on September 11, 2014 and by the IDB Board of Directors on December 17, 2014.

The project aims to promote the development and transfer of environmentally sound technologies (ESTs) in Latin American and Caribbean (LAC) countries in order to contribute to the final goal of reducing greenhouse gases (GHG) and vulnerability to the effects of climate change (CC) in specific sectors of the region.

This consultancy is conducted within the framework of the IDB-GEF project and mainly focuses on analyzing and disseminating innovative and successful case studies of street lighting (SL) projects as well as business models that have been used in the LAC region for these types of projects.

INTRODUCTION

In our region, SL is a predominantly municipal service. Municipalities are responsible for delivering the SL service to their citizens. In addition, they must invest financial, technical and human resources to manage all this. Despite this, not all municipalities have all the financial and technical tools available to have optimal management, causing delays in investments, maintenance tasks or simply management. In many cases, this has a direct impact on the tax situation of the municipality. Finding means for reducing the costs of management and energy is an interesting area of opportunities with direct effects on the technical/financial aspects of municipalities and with possible positive externalities in other areas of society, such as the reduction of global and local GHG emissions.

Therefore, the SL sector today represents an area of opportunity, and even more so with the technological changes resulting from the arrival of LED lights on the market and a decrease in their price. This has led to a revolution in terms of the levels of energy efficiency that can exist today in the SL networks of our cities. Furthermore, the municipalities are looking for new business models that will allow them to improve their SL networks with more flexible conditions from the investment and risk distribution approach (technical and financial risks) associated with this type of project.

This document intends to contribute to this discussion and the search for solutions, and has been structured in three sections for this purpose: The first section describes the main characteristics of the components of an SL system; the second section focuses on the description of three business models for the implementation of SL projects; and, finally, the third section provides a detailed analysis of six case studies of SL business models in LAC and establishes lessons learned to determine the critical elements of efficient SL projects in order to reproduce the schemes in other LAC cities.

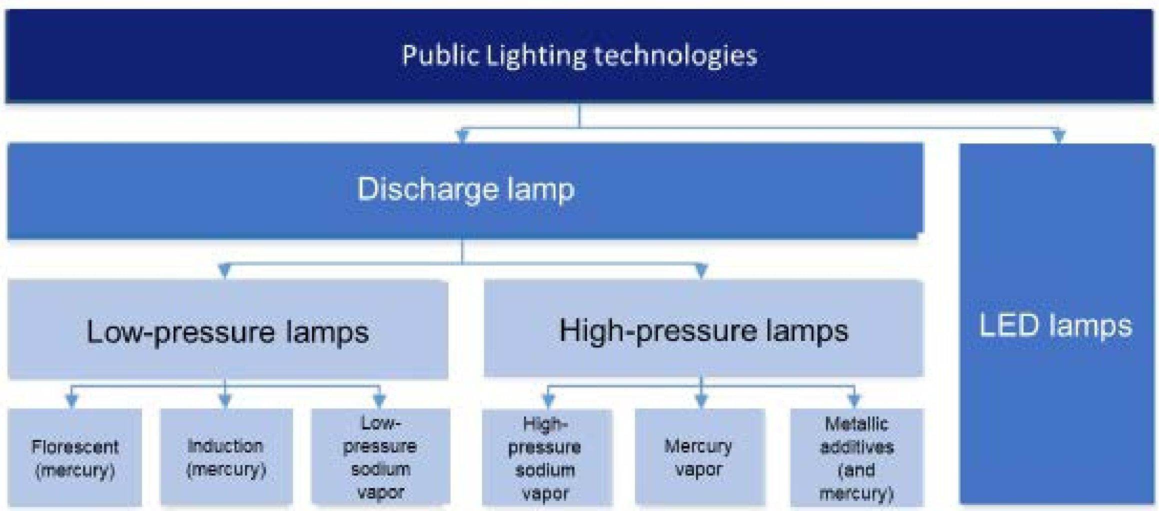
1 CHARACTERISTICS OF THE COMPONENTS OF AN SL SYSTEM

An SL system consists of the following components: (i) light fixture, auxiliary equipment (ballasts and drivers), control/management equipment (twilight switches, astronomical clock, telemanagement); and (ii) additional electrical and infrastructure components (braces, poles, wiring, transformers, etc.).

The light fixture is the source of visible radiation emission, with components to diffuse the light, position and protect the lamp, and connect the lamp to the power supply. Its main components are the reflector, the refractor and the housing.

The technologies currently used in the lamps of SL networks are shown in Figure 1.

Figure 1. Technologies currently used in SL



Source: Compiled by the author

Each lamp type has specific characteristics that provide a different response in terms of luminous efficiency, lumen depreciation, useful life, color temperature, etc.

Some of the most important characteristics of lamps include: (i) the luminous flux, which indicates the amount of light emitted by the lamp; (ii) the color temperature, which describes the color of the light emitted and varies from warm colors (orange) to cold colors (blue); (iii) color rendering index (CRI), which indicates the capacity of the lamp to realistically reveal colors as they appear in natural light; (iv) the useful life of the lamp, which indicates the period of time during which the lamp provides the required levels of light and lumen depreciation.

Table 1 below shows the performance ranges of the main characteristics of the lamps.

Table 1: Specifications of the lamps

Lamp type	Light efficiency (lm/W)[1,2]	Color temperature (K)[1,2]	IRC[1,2]	Useful life (h)[1,2]	Maintenance of luminous flux (%)[3]	Effects of room temperature [4]	Auxiliary equipment[5]	Ignition time (min)[5]	Immediate re-ignition [5]	Adjustable [6]	Prices (US$)[7,8]
Mercury	20 – 40	4.000 – 6.000	15 - 50	16.000 – 24.000	60 – 70	No effect	Ballast	3 – 5	No	No	$80-85
High-pressure sodium vapor	80 – 120	1.900 – 2.200	22 – 70	15.000 – 40.000	75 – 90	No effect	Ballast + starter or electronic ballast	2 – 4	Yes, or with a special device	Yes	$90-100
Low-pressure sodium vapor	130 – 170	1.700 – 1.800	0	16.000 – 18.000	70 – 85	No effect	Ballast + starter or hybrid system	15	Yes, with a special device with two-cap lamp	No	N/A[9]
Metallic additives	40 – 110	3.000 – 4.200	60 – 94	10.000 – 20.000	55 – 80	No effect	Ballast + starter or electronic ballast	5 – 7	No, except with special device	No	$80-100
Fluorescent	80 – 85	2.700 – 5.000	80 – 85	6.000 – 20.000	95	Low temperatures increase the ignition time	Ballast + starter or electronic ballast	Almost instantaneous	Yes	Yes	N/A[10]
Induction	50 – 85	3.500 – 5.000	80 – 85	100.000	65 – 70	Low temperatures reduce the luminous flux	High-frequency generator (electronic ballast)	Instant	Yes	Yes, in some cases[11]	N/A[12]
LED	Hasta 145	2.700 – 7.000	42 – 97	70.000 +	70 – 95	High and low temperatures reduce the lifetime and increase the depreciation of luminous flux	Driver	Instant	Yes	Yes	$300-500

[1] U.S. Department of Energy, *Outdoor Lighting Challenges and Solution Pathways*, March 2016: https://betterbuildingssolutioncenter.energy.gov/sites/default/files/attachments/Outdoor%20Lighting%20Challenges%20and%20Solutions%20Pathways%20Paper.pdf
[2] California Lighting Technology Center, *Outdoor Lighting Retrofits: A guide for the National Park Service and other federal agencies*, Julio 2014: http://cltc.ucdavis.edu/sites/default/files/files/publication/nps-outdoor-lighting-retrofits-guide-july2014.pdf
[3] Institute of Transport Engineers, Kansas City Chapter, Street Lighting Design in KC, September 2014: http://kcite.org/images/meeting/092614/kcite_lighting_presentation__9_26_14___final_.pdf
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[5] ADEME, *Éclairer* juste, Noviembre 2002: https://www.pedagogie.ac-aix-marseille.fr/upload/docs/application/pdf/2012-07/eclairer_juste.pdf
[6] Énergie Plus, *Tableau récapitulatif des principales caractéristiques* : https://www.energieplus-lesite.be/index.php?id=16267
[7] Energy-Efficient Public Street Lighting Project in Rio de Janeiro, World Bank Group, August 2014.
[8] Program of improvement of the Energy Efficiency in Public Lighting Project of improvement of Public Lighting in municipalities of the Province of Buenos Aires - Stage 1. https://www.minfinanzas.gob.ar/uppp/docs/IF-2018-02680585-APN-SSAYEE.pdf
[9] Unavailable price. Obsolete technology.
[10] Unavailable price. Technology for indoor use.
[11] U.S. Department of Energy, *Induction Lighting: An Old Lighting Technology Made New Again*, July 27, 2009: https://www.energy.gov/energysaver/articles/induction-lighting-old-lighting-technology-made-new-again
[12] Unavailable price. Low-demand technology.

2 BUSINESS MODELS

Three different business models are used to manage SL around the world: (i) Models with public–private partnerships (PPP); (ii) energy service companies (ESCO) models; and (iii) municipal or traditional models.

Key Elements of a Business Model

Multiple variants may exist within each business model. In order to analyze this variability, it is agreed that each of the business models is composed of the following elements (see Figure 2).

Figure 2: Key Elements of an SL business model

Source: Compiled by the author

2.1 Models with Public–Private Partnerships (PPP)

There is no single definition in the literature, and the characteristics of PPP models may vary depending on the country and the existing regulations. In this regard, the following definition has been used: A PPP is a “long-term collaboration scheme between a public authority and the private sector for the provision of a public service, where the term is long enough for the private sector to have an incentive to integrate the conditions on the costs of providing the service during the design phase of the project.”

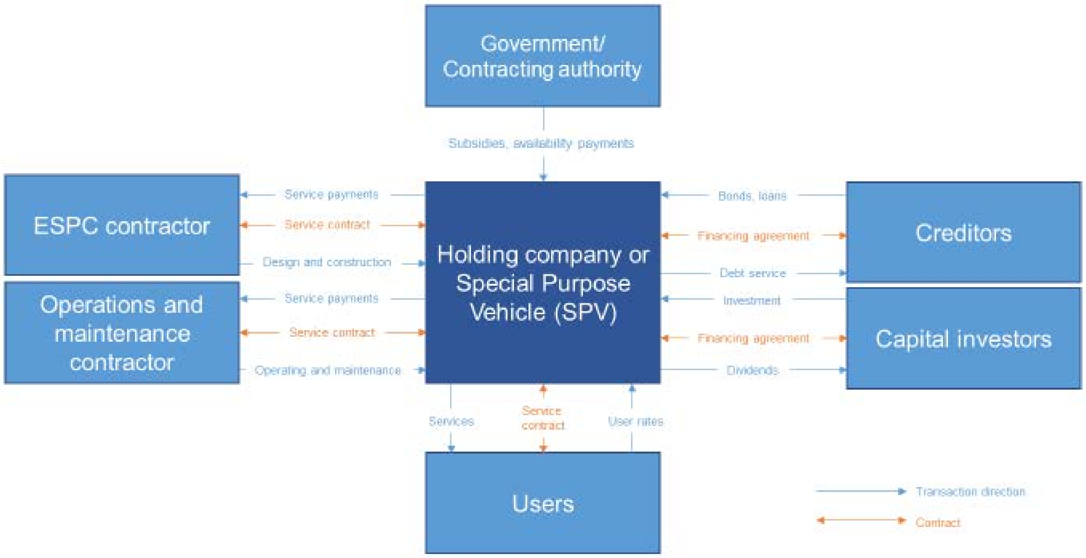
The main characteristics of this model are shown in Table 2.

Table 2: Characteristics of the PPP model

Models with a Public–Private Partnership	
Types of contracts	Created for the private sector to assume a significant part of the risk in the provision of infrastructure Contracts range from design, installation provision, adaptation of facilities, waste management, operation and maintenance, and involve a contract between the private sector and the public sector. The minimum and maximum terms of these contracts are usually defined by the legal framework.
Ownership	Depending on the PPP type, ownership can be left to the private sector and transferred to the public entity once the PPP contract is finalized.
Implementation	The implementation of this type of project must comply with the PPP regulations of the country.
Operation and maintenance	The operation and maintenance of the goods under the PPP contract remain in the hands of the private sector.
Guarantees	They can be retention accounts (ESCROW account) or trusts, among others.
Financing	It is the private sector's responsibility to seek and close the financing for infrastructure.
Repayment mechanisms	There are different mechanisms to structure the repayment of a PPP contract; its modality varies from case to case depending on the country (e.g. direct payments from the state, subsidies, direct rates to the end user).
Advantages	It allows for the partial transfer of the technical and financial risks to the private sector This model has economies of scale and can be used for large projects requiring substantial levels of investment over long periods.
Disadvantages	It must have a minimum investment volume or a minimum number of lamps to be exchanged/maintained in a manner that is attractive to the private entity. Acceptable credit levels are required.

Source: Compiled by the author

Figure 3: Main characteristics of the PPP models



Source: Adapted from PPP Knowledge Lab[13], World Bank, 2017.

2.2 ESCO Model

In this case, private companies develop and/or implement EE investment projects for their clients, whether public or private. The contractual agreement between the client and the ESCO is called an energy services performance contract. Under this scheme, the ESCO analyzes the energy situation of the client (its SL network, in this case), identifies possible solutions to increase efficiency, implements the project and monitors the results.

There are two types of contracts that exist under the ESCO model: Contracts with guaranteed savings and contracts with shared savings. The main differences between the two are in the financing mechanism of works/services and in the form of investment repayment that each model defines.

The main characteristics of this model are shown in Table 3.

[13] This scheme corresponds to a model proposed for an SPV, where the company is created only for a financial transition or specific project.

Table 3: Characteristics of the ESCO model

ESCO Models		
Types of contracts	ESPC contracts with guaranteed savings	Turnkey contracts with the municipality. Monetary savings through the project during the contract are perceived in exchange. There is a guarantee of savings.
	ESPC Shared Savings Contracts	The percentages of participation in savings between the municipality and the ESCO are defined at the contractual level. The risks assumed by the ESCO are higher.
Ownership	ESPC contracts with guaranteed savings	The municipality owns the goods, during the implementation of the works and after finishing the works.
	ESPC contracts with guaranteed savings	The equipment is usually owned by the ESCO throughout the project, and the property is transferred to the municipality once the contract expires.
Implementation		Implementation is the ESCO's responsibility.
Operation and maintenance		The ESCO is responsible for the operation and maintenance of the SL installations implemented in the areas defined in the contract.
Guarantees	ESPC contracts with guaranteed savings	The ESCO guarantees a level of savings for the project throughout the contract.
	ESPC Shared Savings Contracts	There are no savings guarantees.
Financing	ESPC contracts with guaranteed savings	Funding is usually obtained through a third party.
	ESPC Shared Savings Contracts	The ESCO is responsible for providing the financing.
Repayment mechanisms	ESPC contracts with guaranteed savings	The investment is repaid through the monetary savings generated by the energy savings of the project.
	ESPC Shared Savings Contracts	The ESCO offers the services and is partially repaid for the savings generated from the project. In this case, the municipality and the ESCO define the levels of participation in the savings.
Advantages		The ESCO models allow municipalities to overcome a constant barrier to the implementation of SL improvement projects. The implementation scheme also limits technical risk.
Disadvantages		Generally, the projects executed under these models have higher costs than traditional models. There must be a minimum of lighting points to be exchanged, otherwise, the transaction costs of the project (baseline estimate, legal costs, etc.) could be higher than the project costs.

Source: Compiled by the author

The ESCO models with shared savings and guaranteed savings are shown in Figures 4 and 5.

Figure 4: ESCO contract with shared savings

Source: Compiled by the author

Figure 5: ESCO contract with guaranteed savings

Source: Compiled by the author

2.3 Municipal or Traditional Models

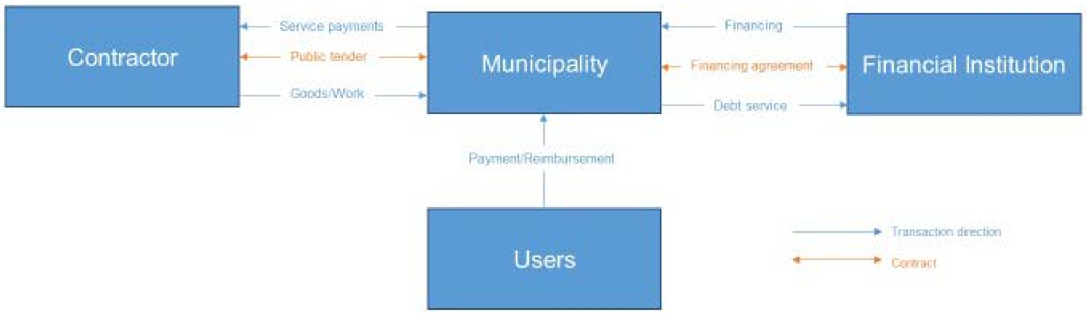
In municipal models, the entire project responsibility, from the design, acquisition and implementation to the operation and maintenance of the project, remains in the hands of the municipal or public sector. While there may be private participation, it is not long term. This model is used in large-scale improvement processes when the municipality has a department focused on SL management and enough personnel dedicated to these tasks.

Table 4: Characteristics of the municipal model

Municipal Models	
Types of contracts	Contracts are made through public tenders. The municipality identifies the appropriate provider and enters into supply and/or service contracts, where the private party is responsible for delivering the requested materials and/or services.
Ownership	Ownership is always in the hands of the municipality.
Implementation	With its own staff, the municipality can be in charge of implementing the EE project. The municipality can contract a private company for this service (installation service, for example).
Operation and maintenance	The municipality, with its own personnel, performs the operation and maintenance tasks or contracts a private company for these services.
Guarantees	The guarantees are those related to the processes of equipment purchase and installation or classic guarantees between the private and public sectors.
Financing	Financing is in the hands of the municipality and depends on budget availability.
Repayment mechanisms	The municipality is directly responsible for the expenses associated with the investment, operation and maintenance of the SL network.
Advantages	It is a simple model where the involved participants are minimized. It is characterized by maintaining ownership, operation and maintenance under the control of the municipality, making investment, operation and maintenance decisions highly flexible. This mechanism may have a lower transaction cost than the other models.
Disadvantages	The municipality assumes all the project risks. Additionally, it must have its own financing, which will determine the size of the investment. The municipality must have enough personnel and resources to perform the tasks of design, implementation, operation and maintenance.

Source: Compiled by the author

Figure 6: Main characteristics of traditional models



Source: Compiled by the author

3 CASE STUDIES

Within the framework of this study, six SL business models in LAC were analyzed to establish the lessons learned and determine the critical elements of each case. The cities analyzed include Buenos Aires (Argentina), Bucaramanga (Colombia), Fortaleza (Brazil), Mexico D.F. (Mexico), Villa Alemana (Chile) and Sonsonate (El Salvador).

Table 5: Studied cases

City	Business model used	Technology used	Project execution status
Buenos Aires	Municipal	LED with telemanagement	Completed (2012 – 2015)
Bucaramanga	Municipal	LED with telemanagement and telemeasurement	Underway (2013 – 2019)
Fortaleza	Service Contract	VM and LED	Underway (2013 –)
Mexico City	Public–Private Partnership	LED	Underway (2010 – 2019)
Sonsonate	Public–Private Partnership	LED with telemanagement	Completed (2014 – 2015)
Villa Alemana	Service Contract	LED	Completed (2015 – 2017)

Source: Compiled by the author

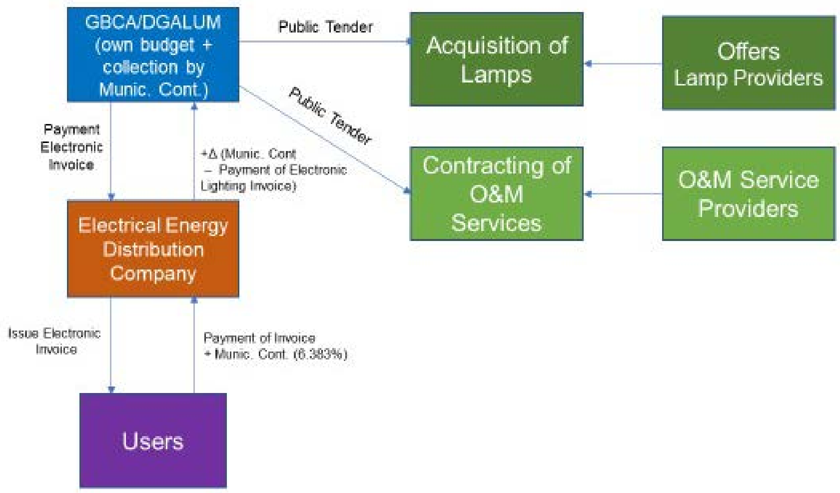
3.1 City of Buenos Aires (Argentina)

This project completed the replacement of 91,000 SL lamps with LED technology with remote management and dimming, which required an approximate investment of US $57 million. The contract for this project was reached through public tender. Moreover, equipment and management systems were acquired through this tender, and a private entity was in charge of implementation. This private entity was also previously hired under public tender. Further, said private entity is responsible for conducting the operation and maintenance of the SL network. To finance this project, the municipality used the money collected from an SL tax, which is equivalent to 6.4% of what users pay for electricity. On the other hand, the municipality pays the power distributor Edenor an electricity tariff equivalent to US $0.094 per kWh and an electricity tariff of US $0.082 per kWh to Edesur.

The project implementation is expected to generate an energy savings of 37.54 GWh and a CO2e emission savings of 54,839 tons.

The business model used is shown in Figure 7.

Figure 7: Business model - ACBA



Source: Compiled by the author

Participants involved and their roles are listed in Table 6.

Table 6: Participants involved - ACBA

Participants	Entity type	Roles
General Directorate of Lighting	Public	Responsible for the administration, maintenance and optimization of the SL Manages the collection of the SL fee
MANTELECTRIC	Private	Companies responsible for maintenance and repairs of the SL
AUTOTROL-CONSTRUMAN	Private	
LESKO	Private	
ILUBAIRES	Private	
SUTEC	Private	
EDENOR	Private	Electric power distributors SL tax collectors
EDESUR	Private	

Source: Compiled by the author

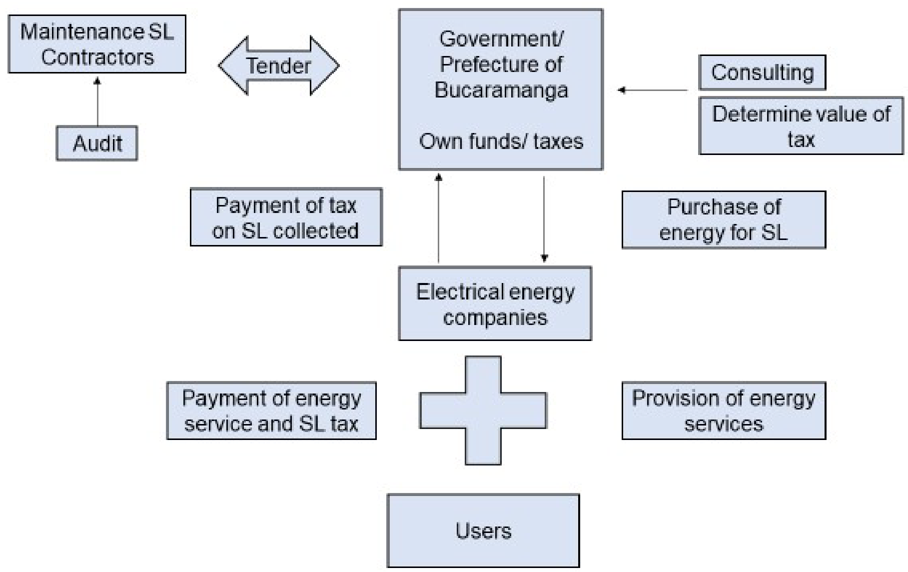
3.2 Bucaramanga (Colombia)

Under the scheme of a municipal or traditional business model, the project for the replacement of 37,989 LEDs is being conducted with telemanagement and telemetry; it began in 2013 and is expected to end in 2019. Through the contractual system, the municipality of Bucaramanga tendered the different aspects of the project implementation (works, adjustments, lighting and maintenance services, among others). The municipality of Bucaramanga financed 100% of its project with its own funds, which come from the proceeds of the SL tax that it charges to users according to the sector of activity (residential, commercial or industrial).

Although there are still no final savings values, with the replacement of 16,200 lamps in 2016, energy savings of 15.8% and CO2e emissions savings of 1,111 tons were reported.

The business model used is shown in Figure 8.

Figure 8: Business model - Bucaramanga



Source: Compiled by the author

Participants involved are listed in Table 7.

Table 7: Participants involved - Bucaramanga

Participants	Entity type	Roles
Mayor of Bucaramanga	Municipal	Manages the collection of the SL fee
SL Office	Municipal	Manages the SL network
Electrificadora de Santander	Public	Power distributor, SL tax collector
EME S.A.	(EMP)	Responsible for SL maintenance
Civarel Ingeniería Ltda.	Private	Responsible for SL maintenance
Coingeser Ltda.	Private	Responsible for SL maintenance

Source: Compiled by the author

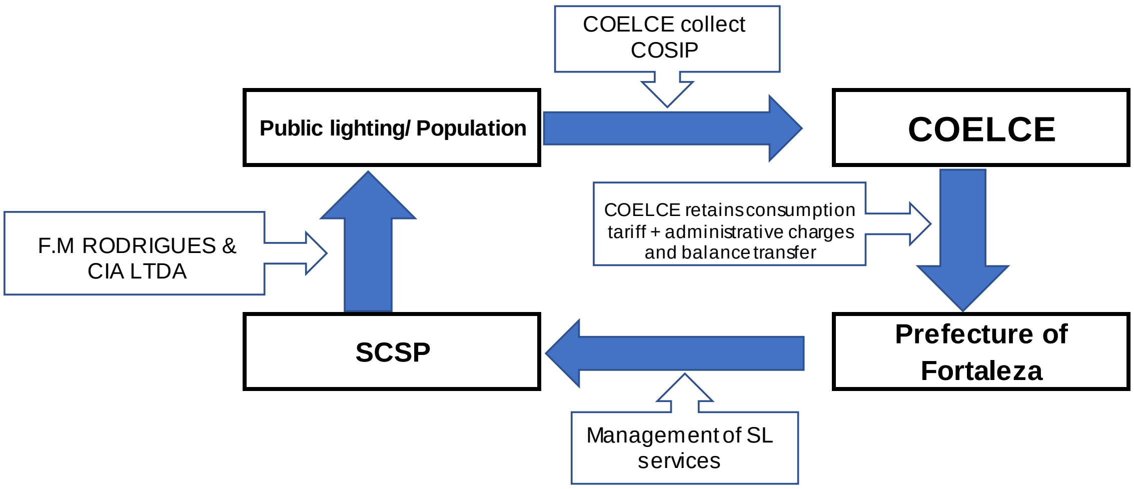
3.3 Fortaleza (Brazil)

The Prefecture of Fortaleza in Brazil developed a plan under a traditional business model to improve street lighting that involved the replacement, repowering, and creation of new lighting points based on Metal Steam and LED technology. Although this project considered the introduction of a telemanagement system, it was not developed.

Since 2014, a private company contracted through a public tender has been providing SL maintenance services and is in charge of executing the works related to the management and maintenance of the SL network. As in the case of the city of Buenos Aires, the Prefecture of Fortaleza finances its SL projects with the collection of an SL tax. On the other hand, the tariff paid by the municipality to the COELCE distributor for SL energy is US $0.11 per kWh.

The business model used is shown in Figure 9.

Figure 9: Business model - Fortaleza



Source: Compiled by the author

Participants involved are listed in Table 8.

Table 8: Participants involved - Fortaleza

Participants	Entity type	Roles
Department of Conservation and Public Services	Municipal	Responsible for managing the SL network
Fortaleza Town Hall	Public	SL tax collector
F.M RODRIGUES & CIA LTDA	Private	Performs the execution of works and engineering services concerning the management of the SL network

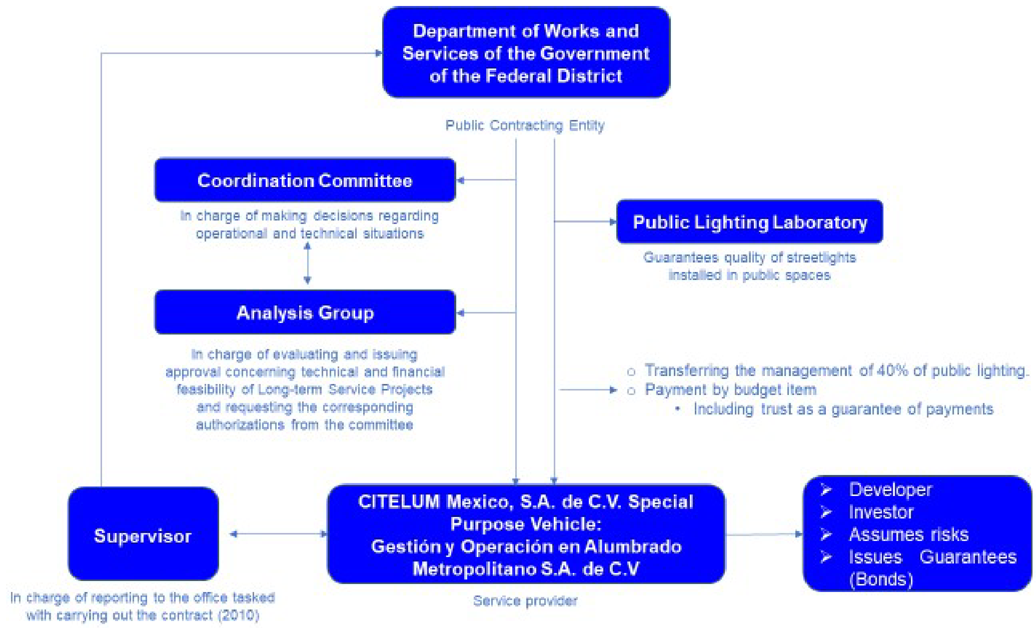
Source: Compiled by the author

3.4 Mexico City (Mexico)

Through a PPP business model, Mexico City (CDMX) in Mexico has launched a long-term service provision project for the rehabilitation, modernization and operation of the SL infrastructure, in addition to the management and preventive and corrective maintenance in various arteries of the primary road network and the artistic lighting service in buildings across Mexico City. With a total investment of approximately US $151 million, the city expects to complete this project in November 2019. CDMX pays the CFE power distributor a tariff of US $0.20 per kWh. The budget and material resources to operate and maintain the SL system come from the current expenses allocated to SL management. Said budget is granted according to the collection of the fiscal year preceding the year of allocation. It is estimated that savings of 25% in energy have been achieved and the emission of 9 tons of CO2 has been avoided.

The business model used is shown in Figure 10.

Figure 10: Business model - Mexico City



Source: Compiled by the author

Participants involved are listed in Table 9.

Table 9: Participants involved - Mexico City

Participants	Type of entity	Roles
SL Management	Public	Responsible for managing the SL network
CFE	Public	Power distributor
CITELUM	Private	Responsible for 40% of the CDMX SL Responsible for the rehabilitation, modernization and operation of the SL infrastructure Responsible for the management of preventive and corrective maintenance in various arteries of the primary road network and the artistic lighting service in buildings in Mexico City

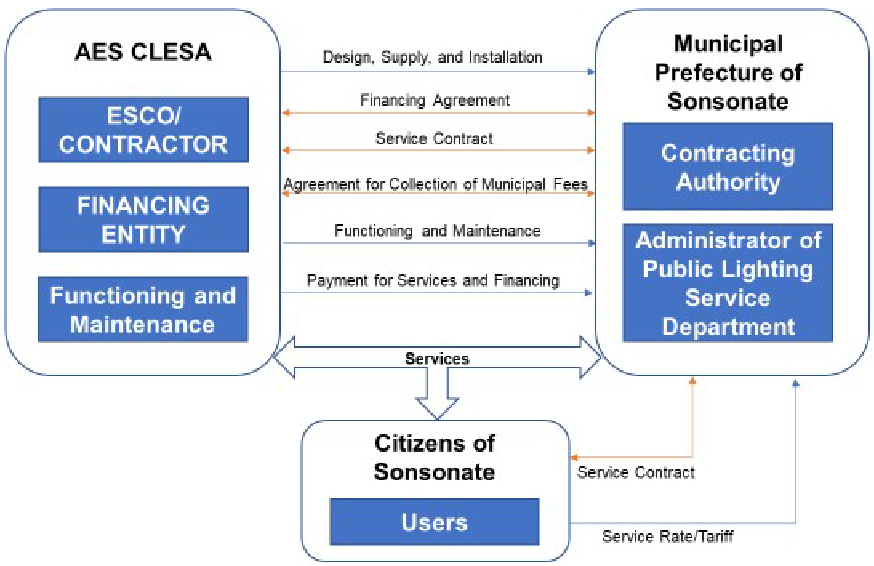
Source: Compiled by the author

3.5 Sonsonate (El Salvador)

Through a PPP business model, Sonsonate replaced 4,024 lamps with LED technology with telemanagement, which involved an investment of close to US $4 million. The existing contract has a duration of 8 years and includes the investment, supply, equipment installation and maintenance of the LED lights of the SL for 4 years. The municipality of Sonsonate charges tax under the SL category; however, the project is being repaid with the money saved in the payment of the electricity bill, and this fee is paid to the AES CLESA power distributor. It is estimated that energy savings are close to 66% and emissions have been reduced by 1,546 tons.

The business model used is shown in Figure 11.

Figure 11: Business model - Sonsonate



Source: Compiled by the author

Participants involved are listed in Table 10.

Table 10: Participants involved - Sonsonate

Participants	Entity type	Roles
Sonsonate Town Hall	Municipal	Responsible for managing the SL network Administration of SL taxes
AES CLESA	Private	Responsible for the investment, supply and installation of equipment in the SL project Provides SL network maintenance for 4 years SL tax collector Power distributor

Source: Compiled by the author

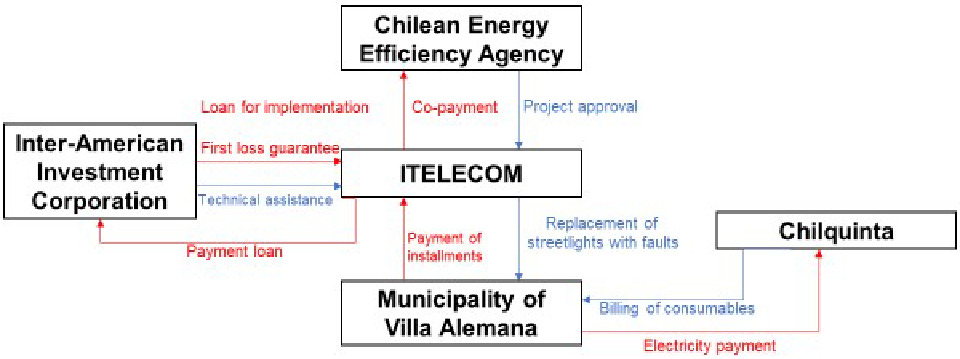
3.6 Villa Alemana (Chile)

The municipality of Villa Alemana (MVA) in Chile implemented an efficient SL program. It consisted of replacing 7,500 lamps with LED technology with an investment of US $4 million. In this case, the project was co-financed by AChEE, who also participated as technical guarantor of the implemented solutions.

Under a model with more significant private sector participation, the MVA tendered the system implementation services (installation, replacement and waste disposal), but not ex-post maintenance. Thus, the investment was made by the private company, but the replacement tasks, once the works are finished, are in the hands of the MVA. This is a contract that allows access to financing, since the investment and services are not repaid from the beginning but rather in 96 installments. This contract includes the provision of technology, but not the maintenance of the SL network, for which the MVA must be commissioned. On the other hand, the MVA does not levy an exclusive tax on SL within its municipal taxes but has general taxes that must cover the expenses of all municipal services. The tariff that the MVA charges to the Chilquinta power distributor for SL electricity is US $0.14 per kWh, where some circuits have charges for energy and power.

Some estimates indicate that this project achieved savings of 64% in electric power and 1,052 tons in CO2e emissions. The business model used is shown in Figure 12.

Figure 12: Business model - Villa Alemana



Source: Compiled by the author

Participants involved are listed in Table 11.

Table 11: Participants involved - Villa Alemana

Participants	Entity type	Roles
Villa Alemana Town Hall	Municipal	Financing entity (owns municipal resources) Responsible for the management and maintenance of the SL
AChEE	Public–Private	Responsible for the technical inspection of the works
Itelecom	Private	Responsible for project implementation Responsible for streetlight guarantees during the useful life of the project (8 years)
Inter-American Investment Corporation	International organization	Financing entity (for Itelecom) First loss guarantor (to Itelecom)
Chilquinta	Private	Power distributor

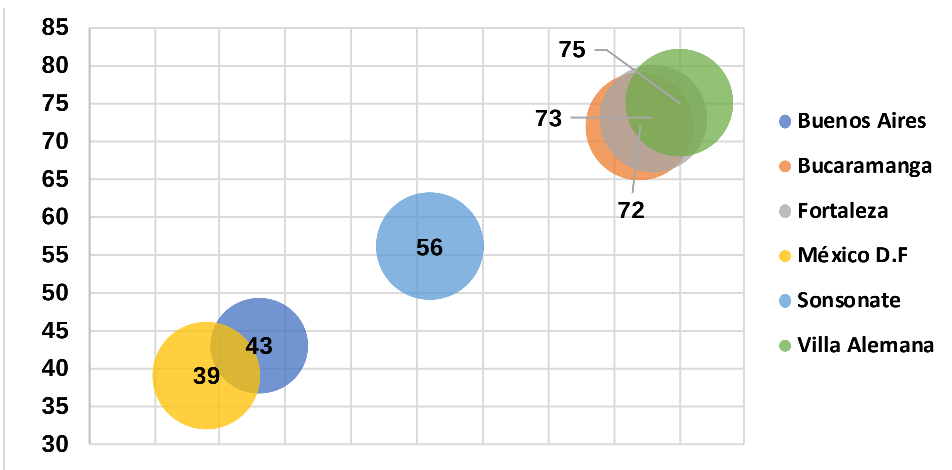
Source: Compiled by the author

4 CONCLUSION

In the LAC region, and in the studied cases in particular, the responsibility for the provision of the SL service is in the hands of the municipalities, which have been introducing private participation at various levels, either for the development of EE projects in SL or for maintenance tasks. In almost all cases, the existence of well-structured regulatory and institutional frameworks, established financing mechanisms and similar tariff structures for the collection of energy associated with SL are appreciated.

The cities analyzed vary considerably in magnitude, in terms of lighting points, investment and the technological complexity of their projects.

Figure 13: Number of lamps in the studied cases for every 1,000 residents



Source: Compiled by the author

In the vast majority of the municipalities studied, the funds for project implementation, operation and maintenance come from taxes or fees relating to the SL category, which are charged to the population through electricity bills.

In half of the studied cases, the business model used is a traditional model, where the municipality tenders the streetlights with its own resources, assuming all the technical and financial risks.

The use of LED technologies has been the unanimous decision at the municipal level, when efficiency is the engine of the project. In addition, in some cases, telemanagement systems have been implemented, improving the monitoring and overall performance of the SL system.

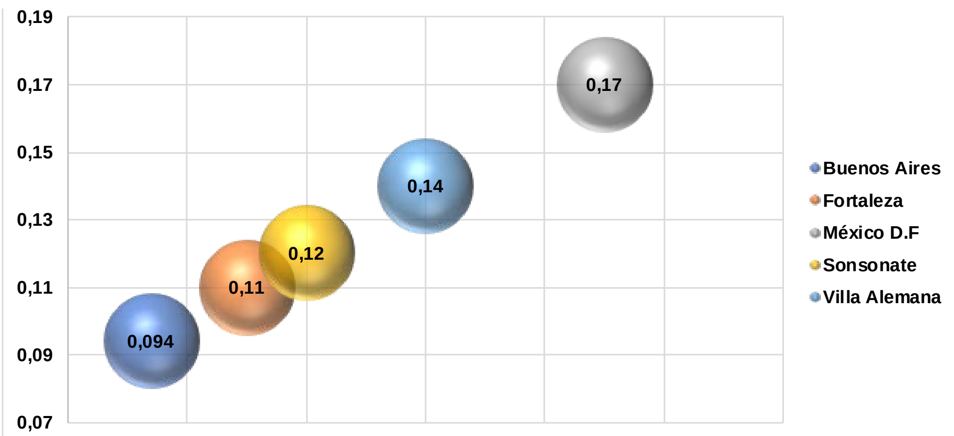
Through this study, it was possible to confirm that there are several items/activities that should be considered when analyzing SL improvement projects. First: the basic information. For proper planning of an SL replacement or expansion project, it is important to have basic information on each of the components (and their status) in order to ensure that lighting replacement designs are in accordance with the existing standard.

It is also important to verify the offers made by technology manufacturers or distributors before starting the project to reduce the risk of information asymmetries and to ensure that the bidding documents are in accordance with the rules and the market.

The tariff structure will have a direct impact on the attractiveness of the project; therefore, during the pre-feasibility process, it is important to verify the contractual terms and conditions and verify the need to negotiate the existing contract with the energy distribution company.

In all the cases analyzed, except for that of Chile, the tariff structure is solely composed of a component associated with energy consumption and there are no charges for power.

Figure 14: Electricity rates for SL in the studied cases (US$/kWh)



Source: Compiled by the author

In an SL project, it is important to identify and measure the SL electric circuits of the municipalities in order to measure the actual consumption, since this is the only way to capture the energy benefits as well as verify the efficiency of the implemented project.

This benefit verification should include the verification of the regulatory lighting parameters in order to comply with the required lighting levels at the lowest possible energy cost.

This study has found that, when municipalities do not have the necessary resources for immediate investment in a project to replace or expand an SL network, models with private participation can be an effective way for municipalities to access resources.

The incorporation of the private sector is therefore possible and, depending on the circumstances, also desirable because they can help break down financial and technical barriers to the proper implementation of SL projects. However, this transfer of responsibilities and risks does not imply that the municipal counterparts do not have a fundamental role to fulfill. In fact, the opposite is true, as the verification of the services delivered and their performance will be in the hands of municipal entities that must ensure the correct fulfillment of the commitments made throughout the duration of the contractual relationship between the parties.

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