

PROVEN DELIVERY MODELS FOR LED PUBLIC LIGHTING

Municipal Financing Delivery Model in Quezon City, Philippines
Case Study #6





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MUNICIPAL FINANCING DELIVERY MODEL: QUEZON CITY, PHILIPPINES

Location	Quezon City, Philippines
Project Dates	2005 to 2018
Project Size	25,000 being retrofitted (total of 45,070 in the city)
Implementing Agency	Quezon City Mayor's Office
Funding Mechanism	Self-financing from allocated national and local taxes
Implementation/ Procurement Process	Implementation by Quezon City
Expected Energy Savings	60%

The National Capital Region, of which Quezon City is a part, faces significant development challenges. One of the greatest is a high concentration of people in a relatively small territory. The region's population density of about 10,000 people per square kilometer is almost twice that of New York City, and is among the highest in the world compared with cities of similar size. The National Capital Region had a population of 5.9 million in 1980, but it has doubled in the last 30 years.¹ The dense, congested character of Quezon City and its neighbors has led to high unemployment, overcrowded and substandard housing, and an excess of garbage not properly managed. As a result, there are many competing priorities for Quezon City's available funds. Within this resource-constrained context, street lighting comprised 65 percent of Quezon City's electricity costs or about 5 percent of its annual budget. The desire to reduce energy costs and allocate resources to other priorities was a key driver behind Quezon City's action on energy efficient street lighting.

Even before undertaking the street lighting retrofit project, however, Quezon City was already proactive in the adoption of environmentally friendly policies. For example, in 2009, Quezon City became the first city in the Philippines to enact a Green Building Ordinance, which specified minimum standards, a rating system, and building inspection and evaluation procedures. In addition to Quezon City's long commitment to environmental improvement, its recent experience promulgating energy efficiency policies and the availability of technical assistance from the World Bank Institute (WBI) were additional factors enabling the City's LED streetlight initiative.

Quezon City is converting 25,000 streetlights to LED technology and expanding street lighting to areas currently not illuminated. The project plans to install at least 5,000 luminaires annually from 2015 to 2018, for a minimum total of 20,000 retrofitted luminaires over four years. In addition, 5,000 luminaires were replaced with LEDs in 2013–14. As of June 2015, a total of 3,856 LED luminaires had already been installed, with a further 2,678 installations under way. The National Road Board is funding installation of an additional 2,046 LED streetlights on major roads in Quezon City that are currently not illuminated. LED lighting will significantly improve illumination on Quezon City's streets, which is expected to lead to a reduction in crime and enhancement of tourist areas at night. Meanwhile, significant energy savings achieved by LED lighting should enable Quezon City to use the budgetary savings to address other social challenges.

CONTEXT

Quezon City, one of 17 local municipalities in the Metro Manila region, is the largest city in the Philippines—about a quarter the size of the National Capital Region and five times larger than the City of Manila. Quezon City's population, which stood at 2.8 million as of 2010, has been growing at the rapid rate of 2.4 percent annually. With over 59,000 registered businesses and as the highest income earning city in the Philippines, it was dubbed by the London *Financial Times* in 2007 as “one of the top ten Asian cities of the future.” Once the capital of the Philippines, Quezon City remains the seat of the Philippines Congress, House of Representatives, and the University of the Philippines. The country's major news and broadcasting companies are also located in Quezon City.

Quezon City's political and administrative climate has been very stable over the past 15 years. This has enabled it to develop a long-term commitment to green initiatives and build a record of developing and implementing successful environmental projects. For instance, in 2007, one of the World Bank's carbon funds purchased emission credits for €1.8 million (US\$2 million) for a project registered under the United Nations Framework Convention on Climate Change's (UNFCCC) Clean Development Mechanism (CDM) consisting of a facility to capture, process, and generate electricity from methane embedded in the Quezon City Controlled Disposal Facility. The successful project yielded an average of 110,000 certified emission reduction credits (CERs) per year over a period of 10 years.

Given the success of the Clean Development Mechanism project, Quezon City approached the WBI to participate in the Carbon Finance Capacity Building (CFCB) Program in Emerging Megacities of the South, a subprogram of the World Bank's global capacity building program, Carbon Finance Assist (CF-Assist).² This program provided hands-on technical assistance for developing carbon finance programs, commencing with a workshop cosponsored with Quezon City on September 28, 2009. At the workshop, the Mayor of Quezon City expressed concern about a key municipal budgetary issue: the expense of the City's street lighting system, which accounted for upwards of 60 percent of its electricity costs.

Meanwhile, on a parallel track, the Philippines Department of Energy was about to conclude the Philippine Efficient Lighting Market Transformation Project (PELMATP). Co-funded by the Global Environment Facility (GEF) and United Nations Development Programme (UNDP) in 2005, PELMATP sought to address barriers against widespread utilization of energy efficient lighting systems in the country. An evaluation of the five-year project concluded that the involvement of a large number of stakeholders, including a vast array of Philippine government officials and private firms, was one of the major achievements of PELMATP.³ The broadened awareness of the potential for energy efficient lighting and the technologies involved helped to set the stage for Quezon City's LED street lighting initiative.

As part of its participation in the WBI technical assistance program, Quezon City became one of the pilot cities in the Energy Efficient Cities Initiative funded by the World Bank's Energy Sector Management Assistance Program (ESMAP). This initiative produced the innovative Tool for Rapid Assessment of City Energy (TRACE) that provides an inter-city benchmarking facility, a playbook of proven energy efficiency interventions, and simple models for the interventions. Improvement in street lighting was one of the recommendations from of this pilot project.⁴

TRACING THE DEVELOPMENT AND IMPLEMENTATION PROCESS

The implementation process in Quezon City is summarized in Figure 1:

Project Development

Quezon City had been actively exploring and implementing upgrades to its street lighting system since 2005. Many streets and roads⁵ were not lit at night, so public safety was an ongoing concern. In 2005, the Mayor issued *Executive Order No. 10*, creating the Task Force on Installation, Repair and Maintenance of Street Lighting. This administrative body was charged with overseeing an initiative to expand nighttime lighting coverage across the city, including formulating policies for site selection, extensions of electrical facilities, and monitoring results. Quezon City subsequently embarked on a citywide street lighting program to illuminate 80 percent of the public road network, totaling about 1,700 kilometers. It involved installing 3,000 new streetlights, with an additional 1,000 streetlights retrofitted by Meralco, a private electricity utility.

At the end of 2009, Quezon City had a baseline total of 45,070 streetlights, as shown in Table 1.

In the past, Quezon City had relied on traditional lighting technologies such as high-pressure sodium (HPS), metal halide (MH), and mercury vapor (MV) luminaires. However, the emergence of the first generation of LED streetlights in 2007 and 2008 prompted a rethinking, since any improvements in energy efficiency would translate into desirable budget savings.

Following the WBI/CF-Assist-sponsored September 2009 workshop, the Carbon Finance Capacity Building Programme in Emerging Megacities of the South funded a study to determine the feasibility of upgrading Quezon City's street lighting to more efficient technology. The project's 2010 report, *Upgrading of Quezon City's Street Lighting Facilities*,⁶ provided the first comprehensive inventory of the city's street lighting and investigated the potential for new high-pressure sodium, metal halide, and LED luminaires to reduce energy use by 20 to 50 percent.

The 2010 Zabala study compared the potential costs and benefits of three technologies: ceramic metal-halide lamps, induction lamps, and LEDs. The study also examined centralized control systems. Table 2 summarizes the results of the analysis. This table shows that, as of 2010, the payback period for metal-halide lamps was high at 26.2 years, but it was much lower for induction lamps (10.4 years) and LEDs (12.8 years).

The study concluded that ceramic induction lamps would be a suitable replacement for HPS street lighting, while LED luminaires, which were quite expensive at the time of the study, would only be suitable for new installations:

Currently [as of 2010], the cost of an LED lamp for street lighting is relatively high. Such investment, however, can be justified if the life cycle cost were to be considered. For one, the life of LED (and induction lamp) is double that of the HPS (i.e., only one LED is needed for every two HPS and for every four MH). The one area in which LED technology offers a significant advantage over induction lamps and other street lighting is ruggedness. Since the LEDs are solid-state devices, they are more resistant to vibration and impact compared to the induction lamps, which are made of glass. LED lamps are, therefore, more suitable for applications where there is high vibration, such as in roadway lighting.⁷

Figure 1: Summary of the LED Street Lighting Implementation Process in Quezon City, Philippines

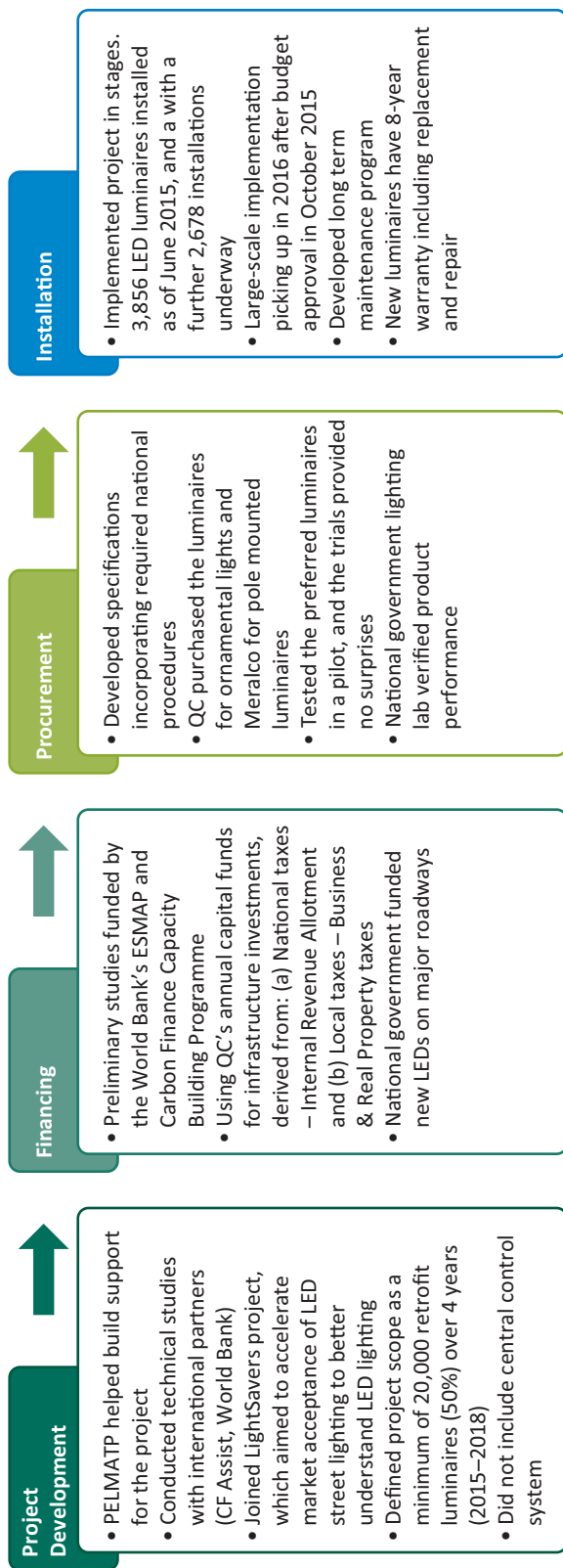


Table 1: Baseline Data for Streetlights at the End of 2009 in Quezon City, Philippines

Description (Charging Mechanism)	Owner	Number of Points	Annual Cost in PHP (US\$)	Percentage of Total
Pole-mounted (flat rate)	Meralco	26,780	127.7 M (\$2.75 M)	49%
Ornamental (flat rate)	Meralco*	3,995	61.7 M (\$1.33 M)	23%
Ornamental (metered)	Quezon City	14,335	72.9 M (\$1.57 M)	28%
Total		45,070	262.3 M (\$5.66 M)	100%

Note: Expanded summaries are available in Chapter II, and the case studies themselves at http://www.esmap.org/Energy_Efficient_Cities.

Other key recommendations included:

- Any replacement options should be subjected to rigorous laboratory and field testing before upgrading the system to ensure proper performance.
- The Task Force should conduct a public survey of pedestrians and motorists to determine their visual preferences regarding warm white light versus cooler daylight. This was flagged as a possible issue given the variety of color temperature options available with LED lighting and negative feedback from cities that had installed cool daylight streetlights.

Table 2: Summary of Energy Savings Study for Total Luminaire Replacement in Quezon City, Philippines

Type of Lamp	Metal-Halide	Induction Lamp	LED
Scenario 1: 14,335 Streetlights			
Energy Savings at 4,380 hours per year (kWh)	1,996,636.14	3,516,088.80	5,902,006.20
Annual energy cost savings @ PHP 10.00 per kWh	19,966,361.40	35,160,888.00	59,020,062.00
Total investment, in PHP	523,227,500.00	365,542,500.00	752,587,500.00
Payback period, in years	26.2	10.4	12.8
Scenario 2: 18,330 Streetlights			
Energy Savings at 4,380 hours per year (kWh)	2,553,075.72	4,495,982.40	7,546,827.60
Annual energy cost savings @ PHP 10.00 per kWh	25,530,757.20	44,959,824.00	75,468,276.00
Total investment, in PHP	669,045,000.00	467,415,000.00	962,325,000.00
Payback period, in years	26.2	10.4	12.8
Scenario 3: 21,330 Streetlights			
Energy Savings at 4,380 hours per year (kWh)	2,970,927.72	5,231,822.40	8,781,987.60
Annual energy cost savings @ PHP 10.00 per kWh	29,709,277.20	52,318,224.00	87,819,876.00
Total investment, in PHP	778,545,000.00	543,915,000.00	1,119,825,000.00
Payback period, in years	26.2	10.4	12.8

Note: PHP = Philippine pesos

- Ornamental lights owned by the utility, Meralco, should be transferred to Quezon City's ownership and operated on metered rather than a flat-rate billing. This would maximize savings, reduce the overall cost of the fixtures, and eliminate the disincentives associated with the utility's flat-rate billing approach.

Meanwhile, in early 2011, Quezon City joined 11 other large cities in The Climate Group's (TCG) international LightSavers project, which aimed to accelerate market acceptance of LED street lighting. Quezon City staff participated in various TCG workshops, including a global summit held in Shanghai in May 2011, organized by LightSavers, as well as other technical assistance programs and conferences. As a result, their knowledge of and familiarity with LED lighting increased. While Quezon City staff remained open to induction technologies—induction lamps were being tested on the streets—the declining costs and clear optical benefits of LED luminaires became decisive. A WBI team visited Quezon City in June 2012 and recommended a set of technical specifications for LED streetlights that Quezon City eventually incorporated into its procurement approach. There was now momentum towards the use of LED luminaires both for new installations, as recommended by the 2010 Zabala study, as well as retrofits.

A constraint arising from the conversion of Quezon City's streetlights to LEDs was the split ownership of the assets and the flat rate charged by Meralco on a portion of the assets, as identified in the 2010 Zabala study. To solve this, in March 2013, the Mayor of Quezon City signed a Memorandum of Agreement with Meralco that turned over the nearly 3,000 ornamental streetlights owned by the utility to the Quezon City government for a price of PHP 5.7 million (US\$126,000). Meanwhile, the City installed meters on all of the ornamental streetlights so that savings from the retrofit of LEDs would yield energy cost savings. For the remaining pole-mounted streetlights that are owned by Meralco, the utility on its own authority has undertaken a project to convert the streetlights in its ownership to LEDs. Since Quezon City continues to pay Meralco a flat rate per pole, the LED retrofit undertaken by Meralco increases their profit and the city benefits from better lighting.

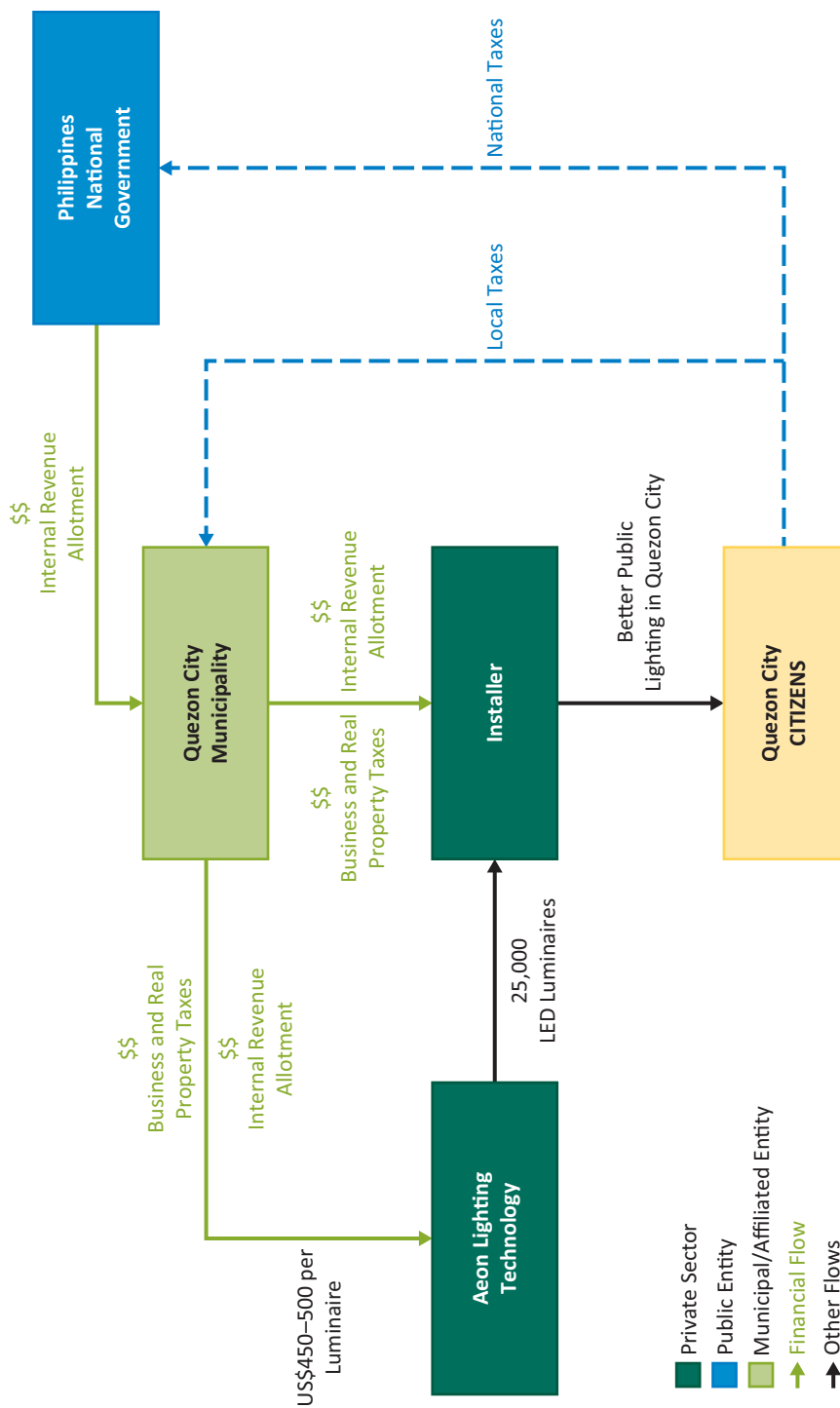
Financing

The LED streetlight project is financed mostly from Quezon City's own capital funds, with the national government providing funding for installation of new LED luminaires and poles on the major roadways. Quezon City's annual capital funds for infrastructure investments are derived from national and local taxes. The main sources of revenue for infrastructure are the Internal Revenue Allotment, which is a national tax, and Business and Real Property taxes, which both come from local taxes. Figure 2 summarizes the overall flows.

Quezon City has an excellent international credit rating of A+ from Standard & Poor's (S&P) for its solid liquidity levels, strong budgetary performance, debt-free position, and financial flexibility. S&P noted in its 2009 evaluation that while Quezon City had kept its rates and charges low, with property valuation among the lowest in Metro Manila, the City enjoys a degree of financial flexibility that is substantially higher than its peers. Its liquidity position remains strong, with free cash and liquid assets covering an average of 98.5 percent of operating expenditures from 2003 onwards.

Despite this excellent credit rating, however, Quezon City prefers to raise capital for infrastructure investments from tax revenue rather than by issuing debentures, which would entail additional interest costs to the municipality over time.

Figure 2: Notional Flows for the Municipal Financing Model | LED Street Lighting Retrofit in Quezon City, Philippines



Procurement

From 2012 to 2015, Quezon City staff planned and began preparing for a full-scale retrofit of existing streetlights by continuing to test various LED luminaires, undertaking two procurement cycles, and preparing requests for capital submission during Quezon City's annual October budget call.

After a comprehensive baseline study and subsequent technical assistance, both funded by the WBI, Quezon City staff undertook extensive LED trials. Once these steps were concluded, Quezon City launched its LED streetlight renewal project in 2014 under the auspices of the Task Force on Streetlights.

Bidding on government contracts in the Philippines is restricted to Philippine companies or ventures in which at least 60 percent of the ownership is vested in Filipino citizens. This is a major constraint for foreign lighting companies, which would need to form joint ventures or partnerships with Philippine companies in order to qualify, thus adding costs and administrative layers to their bids.

The first procurement bid was issued in October 2012 in conformance with the Government of the Philippines Bidding Documents (PBD), which outlines procedures and regulations mandatory for all branches of governments, including local government units. The Bidding Documents require definition of: (a) the objectives, scope, and expected outputs and/or results of the proposed contract; (b) the eligibility requirements of bidders, such as track record, to be determined by the Head of the Procuring Entity; (c) the expected contract duration; (d) the estimated quantity (and in the case of procurement of goods, delivery schedule and/or time frame); and (e) the obligations, duties, and/or functions of the winning bidder.⁸

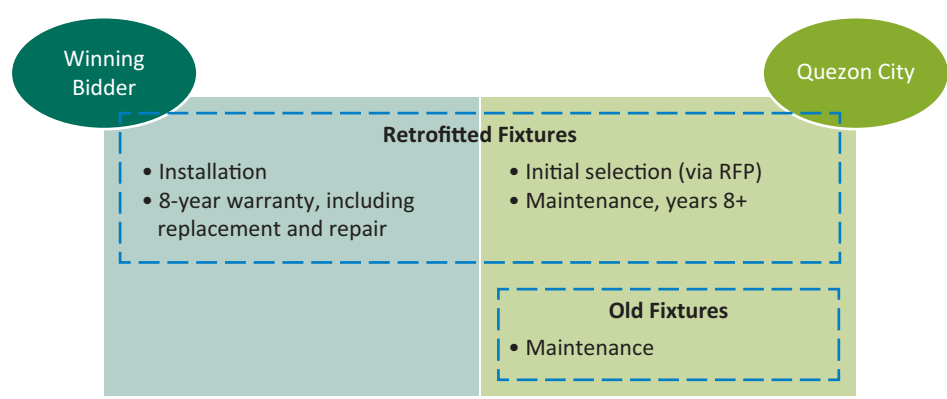
After issuance of the LED streetlight Request for Proposals (RFP) in October 2012, nine bidders bought the bidding documents and five bidders submitted official proposals. All, however, were disqualified by the Quezon City Bids Awards Committee, as none of the proposals met the requirements. Some of the requirements of the bid relating to local manufacture and green job creation may have discouraged potential bidders. The bids that were submitted failed mostly because the proponents were unable to demonstrate experience in installing LED luminaires in a large project such as this one.

Quezon City staff undertook a second bid on July 29, 2013, with more flexible requirements on local manufacturing. Seven bidders purchased the bidding documents this time and four eventually submitted bids. The winning bid was from a wholesale firm that partnered with Aeon Lighting Technology, a Taiwanese company, offering the lowest price of US\$450 to US\$500 per luminaire while meeting all technical requirements of the bid. The bidder offered an eight-year warranty, including replacement and repair of defective units free of charge for equipment and labor. As a part of the procurement process, the national lighting laboratory administered by the Philippines Department of Energy assisted in the testing of the Aeon luminaires to ensure that they met bidding technical specifications.

Installation

The project aims to install a minimum of 5,000 luminaires annually from 2015 to 2018, for a minimum total of 20,000 retrofitted luminaires. Some LED replacements were accomplished in 2013 to 2014, prior to the formal start of the current initiative, so the

Figure 3: Stakeholder Responsibilities for Street Lighting Installation and Maintenance in Quezon City, Philippines



total of retrofitted luminaires through 2018 is expected to be around 25,000 units. HPS lamps with nominal wattages of 150 watts, which primarily illuminate secondary roads, are being replaced by LED luminaires from Aeon Lighting. Meanwhile, the 250-watt HPS lamps on primary roads are being replaced by the National Road Board, which will then turn over ownership of the new luminaires to the local government. The responsibilities for installation and maintenance of the project are summarized in Figure 3.

By 2018, it is expected the city will have more than 50 percent of its lighting points retrofitted. The total estimated cost of the four-year retrofit project is PHP 800 million (US\$17.8 million).⁹ This does not include funds budgeted and spent for new installations. Quezon City originally expected energy savings of 50 percent (for retrofitted lighting points), but staff report higher savings in the range of 60 percent on average.

As of June 2015, a total of 3,856 LED luminaires had been installed, with a further 2,678 installations under way. The National Road Board is funding installation of an additional 2,046 LED streetlights on major roads in Quezon City that are currently not illuminated. In the future, the Road Board may fund additional LED streetlight projects, depending on the type of roads to which they seek to expand illumination.

LESSONS LEARNED

Quezon City’s street lighting retrofits with LED luminaires, almost fully funded with capital derived from national and local taxes, will enable the City to lower its electricity utility costs, reduce its carbon emissions, improve the quality of streetscape lighting, and enhance public safety. This program is a model for other cities that have the political stability, motivation, and financial capacity to form and successfully implement partnerships with national and international agencies. The planning process can be accelerated by aligning incentives, addressing metered versus deemed consumption challenges with the utility, and undertaking procurement that seeks to maximize opportunities for local and international lighting companies to bid their products in response to a tender. Several lessons can be learned from Quezon City’s experience.

1 | Consistent local and international support over time can have an impact.

In the case of Quezon City, technical assistance from the WBI, LightSavers, GEF, and UNDP over a period of time appears to have played a decisive role in expanding local awareness, disseminating technical knowledge, and reinforcing staff leadership.

2 | **Technical knowledge is key for a successful procurement process.**

The support of a well-equipped lighting laboratory and testing capability, in this case managed by the national government through the Philippines Department of Energy, was indispensable in enabling Quezon City staff to test and verify the performance of LED luminaires proposed in the bid responses. Such verification was needed to increase confidence in LED luminaires and increase the likelihood of successful program outcomes.

3 | **Ownership and electricity rate structures can decide program success.**

The flat electricity rate structure employed by Meralco for much of Quezon City's street lighting meant that energy savings would not yield proportionate budget savings for Quezon City. Fortunately, Meralco was able to accommodate Quezon City's desire for metered billing by transferring ownership of the ornamental lights to Quezon City, which were then converted to metering. The remaining non-ornamental streetlights will remain in Meralco's ownership. Therefore, Meralco will enjoy the savings from its LED retrofit while Quezon City will continue to pay its normal flat rate¹⁰ for those streetlights and get better lighting.

The potential integration of a remote monitoring and adaptive control system with LED luminaires may provide an effective alternative to flat-rate billing. Such controls can accurately track and store data related to the usage of each individual luminaire, from hour to hour and day to day. Although the utility may eventually lose revenue (due to reduced consumption), networked controls improve customer service, reduce energy and maintenance costs, and create a platform for novel revenue-generating applications in the future.

4 | **Consider national policy and municipal needs in the project design.**

The procurement process was hampered by national policy that impeded many reputable international companies from bidding on Quezon City's tender. Requirements in the tender favored by Quezon City proved challenging for local lighting companies registered in the Philippines. A second tender round was required and the pool of bidders was limited to those lighting companies that were able to form ventures with Philippines wholesale firms qualified to bid under national law.

ENDNOTES

- ¹ R.B. Singh, Ed., 2014. Urban Development Challenges, Risks, and Resilience in Asian Mega Cities (Springer), p. 453.
- ² From 2005 to 2009, the Carbon Finance Assist program helped developing countries participate in carbon markets and benefit from the Clean Development Mechanism and Joint Implementation flexible mechanisms under the Kyoto Protocol. More information about the current status of this program is available at: <http://wbi.worldbank.org/wbi/about/topics/carbon-finance-assist>
- ³ CREARA, December 2011. Final Evaluation: Philippines Efficient Lighting Market Transformation Project (PELMATP). UNDP.
- ⁴ ESMAP, 2010. Annual Report. Washington, DC: World Bank.
- ⁵ The term *street* is generally used in an urban context, whereas a *road* is a strip of land connecting two or more destinations over which people and goods are transported.
- ⁶ Arturo M. Zabala, June 2010. Upgrading of Quezon City's Street Lighting Facilities. Washington, DC: World Bank/CF-Assist.
- ⁷ Zabala, Ibid., p. 23.
- ⁸ Government of the Republic of the Philippines, December 2010. Philippine Bidding Documents, Procurement of Goods, Fourth Edition.
- ⁹ Quezon City, Project Brief Summary, 2014.
- ¹⁰ In some cases, cities are able to negotiate a reduced flat rate after installing LEDs.

ACRONYMS AND ABBREVIATIONS

CDM	Clean Development Mechanism
CFCB	Carbon Finance Capacity Building Programme
CF-Assist	Carbon Finance Assist
GEF	Global Environment Facility
HPS	High-pressure sodium
kWh	kilowatt hour
LED	Light-emitting diode
PELMATP	Philippine Efficient Lighting Market Transformation Project
PHP	Philippine peso (currency)
RFP	Request for Proposals
S&P	Standard & Poor
TCG	The Climate Group
TRACE	Tool for Rapid Assessment of City Energy
UNDP	United Nations Development Programme
US\$	United States dollar (currency)
WBI	World Bank Institute

PROVEN DELIVERY MODELS FOR LED PUBLIC LIGHTING

Municipal Financing Delivery Model in Quezon City, Philippines, is one in a series of seven knowledge products produced by ESMAP in an attempt to help cities work through the challenges associated with implementing LED public lighting programs. The publications include six case studies and a synthesis report which summarizes the case studies. Each case study describes the context in which decisions were made, then recounts the problems encountered and solved to realize the implementation of the programs. The challenges include real-life examples of: cities managing to attract private sector participants to provide necessary financing and technical expertise; programs implemented in municipalities that are not creditworthy and have limited policy and institutional support; small municipalities of about 2,500 residents as well as cities with several million residents; cities managing perceived risks; and cities effectively handling the measurement and verification of electricity savings accruing from the implementation of more efficient LEDs.



Proven Delivery Models for LED Public Lighting | Synthesis of Six Case Studies

CASE STUDIES



- 1 ESCO Delivery Model in Central and Northwestern India: Asian Electronics, Limited



- 2 Super-ESCO Delivery Model in Vizag, India: Energy Efficiency Services, Limited



- 3 Joint Procurement Delivery Model in Ontario, Canada



- 4 Public-Private Partnership Delivery Model in Birmingham, United Kingdom



- 5 Lease-to-Own Delivery Model in Guadalajara, Mexico



- 6 Municipal Financing Delivery Model in Quezon City, Philippines

Written by I Pedzi Makumbe, Debbie K. Weyl, Andrew Eil, and Jie Li

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For more information about ESMAP's Energy Efficiency program and public lighting transformation activities, please visit us at http://www.esmap.org/Energy_Efficient_Cities

Energy Sector Management Assistance Program

The World Bank

1818 H Street, NW

Washington, DC 20433 USA

email: esmap@worldbank.org

web: www.esmap.org