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Energy-Efficient Urban Street Lighting

India: Energy-Efficient Street Lighting—Implementation and Financing Solutions

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**India:**

**Energy-Efficient Street Lighting—  
Implementation and Financing Solutions**

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## UNITS OF MEASURE

Crore	10 Million
GWh	Gigawatt-hour
K	Kelvin (degrees)
KWh	Kilowatt-hour
lm	lumen
m	Meter
mA	Milliampere
mm	Millimeter
M	Million
MW	Megawatt
Tj	Junction temperature
W	Watt

## ACRONYMS AND ABBREVIATIONS

AC	Alternating current
AEL	Asia Electronics Limited
AMC	Akola Municipal Corporation
BEE	Bureau of Energy Efficiency
BIS	Bureau of Indian Standards
BMC	Bhubaneswar Municipal Corporation
BOT	Build-Operate & Transfer
CCT	Correlated Color Temperature
CIE	<b>Commission Internationale de l’Eclairage</b>
CLASP	The Collaborative Labeling & Appliance Standards Programs
CMC	Centralized Monitoring Control
CMS	Central Management System
DC	Direct current
DfT	Department for Transport
DPR	Detailed Project Report
DSM	Demand Side Management
DWP	Department of Water and Power
EC Act	Electricity Conservation Act
ECM	Electricity Conservation Measures
EE	Energy efficiency
EESL	Energy Efficiency Services Limited
EoI	Expression of Interest
EPC	Engineering Procurement Construction
EPI	Energy Performance Insurance
ESCO	Energy service company
ESMAP	Energy Sector Management Assistance Program
ESP	Energy Service Provider
ESPC	Energy Savings Performance Contract
FI	Financial institution
GHG	Greenhouse gas
GIS	Geographic Information System
GoAP	Government of Andhra Pradesh
GPRS	General Packet Radio Service
GSM	Global System for Mobile Communications
GVMC	Greater Vishakapatnam Municipal Corporation
HID	High Intensity Discharge Lamp
HPM	High Pressure Mercury
HPS	High Pressure Sodium
HPSV	High Pressure Sodium Vapor
H&UDD	Housing and Urban Development Department
IFC	International Finance Corporation
IGA	Investment Grade Audit
INR	Indian Rupees
IPMVP	International Performance Measurement and Verification Protocol
JNNURM	Jawaharlal Nehru National Urban Renewal Mission
KfW	Kreditanstalt für Wiederaufbau
KVa	Killovolt Ampere
LADWP	Los Angeles Department of Water & Power
LCA	Life cycle analysis
LCC	Lifecycle Cost Calculation
LED	Light-emitting diode
M&V	Monitoring and Verification
MC	Municipal Corporation
MH	Metal Halide
MIS	Management Information System

MJP	Maharashtra Jeevan Pradikaran
MNRE	Ministry of New and Renewable Energy
MoUD	Ministry of Urban Development
MOU	Memorandum of Understanding
MSMEs	Micro, Small, and Medium Enterprises
Mu DSM	Municipal Demand Side Management
MV	Mercury vapor
NLC	National Lighting Code
NMEEE	National Mission on Enhanced Energy Efficiency
O&M	Operation and maintenance
OM&R	Operation & Management
PFI	Private Finance Initiative
PPP	Public-Private Partnership
PRGF	Partial Risk Guarantee Facility
PRGFEE	Partial Risk Guarantee Facility for Energy Efficiency
PRSF	Partial Risk Sharing Facility
PSU	Public Sector Undertaking
RFP	Request for Proposal
SEAD	Super-efficient Equipment & Appliance Deployment
SLA	Service Level Agreements
T <sub>j</sub>	Junction Temperature
TNUDF	Tamil Nadu Urban Development Fund
ULBs	Urban Local Bodies
USAID	U.S. Agency for International Development

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The preparation of this report was led by Ashok Sarkar of the World Bank (Senior Energy Specialist, Global Energy Practice and Task Team Leader), in partnership with a team from Energy Efficiency Services Limited (EESL) led by Saurabh Kumar (Managing Director), Neelima Jain (National Program Manager), and Venkatesh Dwivedi (DGM). The report was drafted by the technical consulting team of Sanjay Dube, Prima Madan, Amit Tripathi and Ameya Udgaonkar, all from the International Institute for Energy Conservation (IIEC)’s India office, who worked in close collaboration with and under the directions of EESL and the World Bank.

Throughout this project, positive and active support from EESL team helped in making this Report a comprehensive Manual with practical information on implementation of energy efficient street lighting projects in the urban sector in India. In addition, the Report draws extensively from the global practices in this field, including from those which were also presented by various international speakers at the Global Conference on Energy Efficiency in Street Lighting, organized by the World Bank jointly with IFC, EESL and the Bureau of Energy Efficiency (BEE), in New Delhi in March 2014.

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## ABOUT THE MANUAL

There has been a clear need for energy-efficient technologies that could be applicable in the municipal street lighting sector. This manual is written with the objective of supporting the preparation and implementation of street lighting projects in India, using performance contracting and other Public Private Partnership-based delivery approaches.

This manual draws upon global best practices, including practices that have been tried and proposed within India and South Asia; and draws from their failures and successes to document the major lessons learned. The manual should be useful for its readers for assessing options and developing practical solutions for scaling up the implementation of large street lighting programs in cities and municipalities.

The contents of this manual are designed to act as a practical resource to support industry players, such as equipment suppliers and energy service providers, and government authorities to implement energy efficiency (EE) projects in urban street lighting. This manual has been designed according to the requirements and constraints specific to India. However, many of its recommendations may be applicable across urban local bodies (ULBs) and municipalities in other countries.

## Structure of the Manual

The manual provides a brief overall background of EE in India, the kind of barriers faced in the implementation of EE projects, and the kind of prevalent policy environment for EE in the country. Thereafter, the manual is divided into eight sections. Each section is dedicated to a specific aspect of EE implementation in street lighting:

**Section 1** of the manual provides an overview of energy-efficient street lighting, its components, Indian standards for outdoor lighting, the key lamp technologies, and the potential for intelligent street lighting systems. These factors would help policymakers and stakeholders in chalking out the initial steps to EE programs in street lighting.

**Section 2** highlights the financial models for implementation of street lighting projects. The financial models mentioned in this section focus on public procurement-based models and public-private partnership models in EE street lighting.

**Section 3** describes the essentials of undertaking a detailed energy audit to develop robust baselines.

**Section 4** of the manual is focused on procurement and contracting. It provides a description of key components of Energy Savings Performance Contracts, as well as other documents needed apart from implementation models for EE street lighting projects.

**Section 5** describes methodologies for developing monitoring and verification (M&V) protocols for EE street lighting projects.

**Section 6** brings together the useful tools and matrices in implementation of street lighting projects.

**Section 7** lists the key stakeholders involved in India in such projects and their potential role. This section also highlights the components of capacity building programs focused on implementing EE in street lighting projects.

**Section 8** of the manual provides details on international and Indian case studies on implementing EE in street lighting and key lessons from these case examples.

The critical templates for documentation in the process of implementation of EE in street lighting are included as appendixes to this manual.

## Energy Efficiency in Street Lighting—Identifying the Need

India's urban transformation shows a significant opportunity to address municipalities' future energy usage, an insight to their greenhouse gas (GHG) emissions, their energy requirements, and their budgets. In order to disengage the limited city budget from the supply constraints of current energy systems, it is essential to ensure that cities develop in an energy-efficient manner and contribute to national energy security. Street lighting, water/sewage pumping, and buildings have the highest consumption of a city's share of energy. As a city grows and expands, the energy needed to meet the growth increases rapidly. Once installed, the street lighting systems, pumping systems, and building stock remain in use for 15-30 years, thus locking in energy usage for years. With new energy-efficient lighting technologies like LEDs (light-emitting diodes) available in the market today, streetlights represent one of the most cost-effective opportunities for energy savings and for reducing municipalities' energy costs and GHG emissions. As street lighting loads require electricity during peak demand hours, EE street lighting projects are considered attractive investment projects by electricity supply utilities also. In India, street lighting consumed about 8,478 GWh of electricity in FY13, about 1.5% of total national electricity consumption, and that figure can be reduced by 25 to 60% through the use of energy-efficient LED technologies (EESL 2013). More so, from the ULB's point of view, street lighting has either inadequate or poor infrastructure and incurs high maintenance costs, often amounting to 10–15% of a typical municipal budget. Installing efficient technologies as cities expand and retrofitting existing systems would ensure these energy savings, and consequent GHG emissions reductions, for multiple decades to come.

Street lighting services presents immense opportunities for energy savings because of their scale and visibility in the public domain. Use of efficient lighting infrastructure could help reduce the energy usage between 25 and 60 percent in India. For instance, retrofitting the entire conventional streetlights with LEDs in the country could result in a potential annual savings of 4,300 million KWh, which is about 50% of total energy consumed. In addition, operational optimization, such as the use of twilight switching controls and dimming and voltage optimization, could lead to an additional energy savings of 15-20%. The total opportunity of energy savings at the national level, could increase from 4,300 million KWh to about 5,000 million KWh annually. Assuming a power cost of INR 5 per KWh, this translates to an annual cost savings of INR 2,500 crores (EESL 2013).

Given the immense potential, several implementation models are available across the world for achieving EE in street lighting projects. Public-private partnership— (PPP-) based models such as energy savings performance contracting (ESPC) models—offered by energy service companies (ESCOs) or other energy service providers—have become common tools to enhance the sustainable use of energy through EE measures and have been used by municipalities and cities to implement street lighting programs in many parts of the world. The performance contracting structure has proved successful with municipal authorities in many developed markets such as France, Germany, UK and USA, as well as emerging economies as Chile, Thailand, Brazil, South Korea and Mexico. However, actual implementation of large-scale, efficient street lighting through market-based mechanisms such as ESCOs, remains limited in developing countries because of a wide range of barriers, such as lack of reasonable and robust baseline conditions, M&V of energy savings, and unappealing terms and conditions of the contract (such as long payback periods and duration of contracts). In developing economies like India a huge municipal energy-efficient street lighting market therefore remains untapped.

## Barriers to Accelerating Energy Efficiency in Street Lighting

All across the globe Municipal (Mu) Demand Side Management (DSM) approaches provide the city administration an opportunity to improve their systems and operations to conserve electricity and reduce GHG gas emissions. More than half of the world population lives in the cities and as this figure is going to increase substantially as emerging and developing economies are moving towards rapid urbanization. Therefore, it is important to integrate and develop stable institutional arrangement and capacity to increase penetration of EE technologies through Mu DSM.

Within municipal sector, street lighting presents extensive opportunities for energy savings, however actual project implementation and scalability of such projects are yet to be achieved, as there are various barriers to achieve the objectives of EE policies and initiatives in the EE street lighting sector specifically. Key challenge among policy makers across the globe is to design and develop effective policy incentives to promote EE in municipal street lighting sector.

Success of scaling up the EE street lighting technologies depends upon the overcoming of various barriers; these include financial barriers, information and awareness barriers, regulatory and institutional barriers, and technical barriers. Table 1 provides a brief description of these barriers in implementation of EE in street lighting, in general and India in particular.

**Table 1: Barriers to Implementing Energy Efficiency in Street Lighting**

Barriers	Keys Points
<b>Financial</b>	<ul style="list-style-type: none"> <li>• Lack of understanding of EE street lighting investment or perceived risk on the part of the discourse in the financial institutions</li> <li>• Lack of faith in ULBs by financial institutions in India</li> <li>• Poor financial conditions of ULBs in India</li> <li>• Poor financial strengths of ESCOs</li> <li>• Lack of innovative market-based financing mechanisms for implementing EE</li> <li>• Private investors apprehensive of investing in public projects, more so new area like EE</li> <li>• Perceived risk of late/nonpayment by public sector</li> <li>• No familiarity of financial institutions with appraising EE projects and documentation involved</li> <li>• Lack of financial instruments dedicated to EE in Municipal Sector</li> <li>• Lack of understanding of performance risk and pricing of risks by the ULBs and FIs</li> <li>• Lack of assets that can be hypothecated by the lender or banks</li> <li>• Small project sizes</li> </ul>
<b>Information and Awareness</b>	<ul style="list-style-type: none"> <li>• Lack of sufficient information and understanding on the part of customer (ULBs) to make rationale consumption and investment decision on introducing EE technologies</li> <li>• Lack of organized information on implementing street lighting projects, in forms of technologies available, key vendors, and so forth</li> <li>• Limited technical knowledge of EE project developers</li> </ul>
<b>Regulatory and Institutional</b>	<ul style="list-style-type: none"> <li>• Institutional bias towards supply side investment</li> <li>• Lack of stable institutional arrangements and mechanism to encourage investment in Mu DSM and EE</li> <li>• Lack of proper institutional mechanisms for coordination among various government agencies and stakeholders</li> <li>• Low priority given to EE relative to other costs in municipal sector</li> </ul>

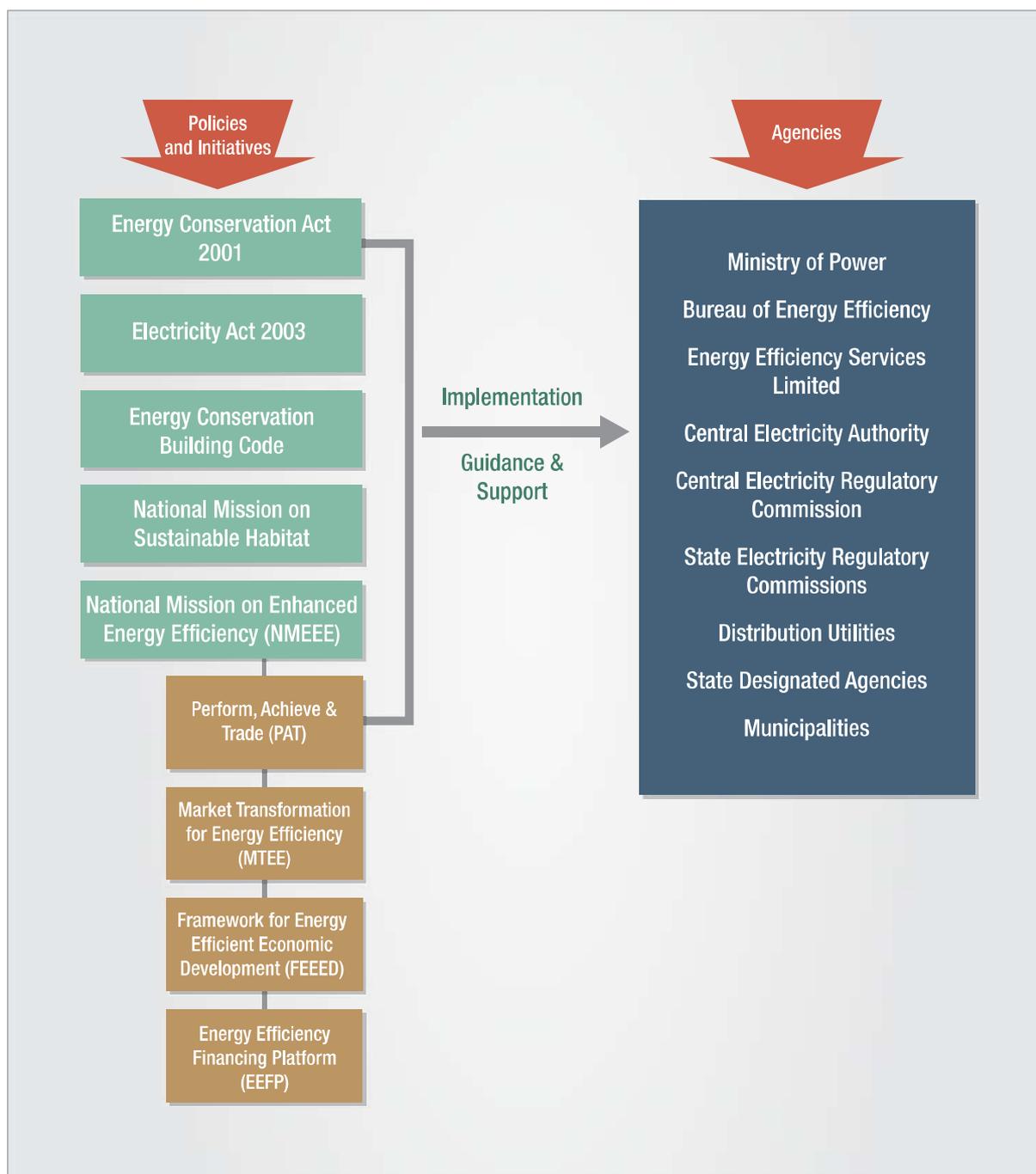
	<ul style="list-style-type: none"> <li>• Rigid procurement and budgeting policies</li> <li>• Limitations on public financing</li> <li>• Lack of clarity in the division of roles between distribution utility and the ULBs</li> </ul>
<b>Technical Barriers</b>	<ul style="list-style-type: none"> <li>• Lack of effective monitoring and verification systems to track energy savings and availability of inadequate infrastructure such as meters</li> <li>• Insufficient local capacities among the ULBs to conceptualize, design and implement such initiatives</li> <li>• Lack of affordable technologies suitable for local conditions</li> <li>• Lack of clarity on part of ULBs on ownership of energy/cost savings</li> <li>• Limited technical, business and risk management skills of service providers</li> </ul>
<b>Infrastructural Gaps</b>	<ul style="list-style-type: none"> <li>• Baseline data of Inventory of streetlights not authentic</li> <li>• Inadequate electrical infrastructure resulting in failure of luminaires</li> <li>• Improper billing practices by the utilities and ULB</li> <li>• Nonstandardized infrastructure in cities (for example, pole span, pole height) and noncompliance with the national guidelines for street lighting standards</li> <li>• High percentage of unmetered lights</li> <li>• Manual operations</li> </ul>
<b>Governance</b>	<ul style="list-style-type: none"> <li>• Lack of policy directives from central and state government</li> <li>• Lack of capacity</li> <li>• Slow decision-making as the issues need to be agreed upon agreed members of local bodies</li> <li>• Lack of coordination between various government and municipal bodies involved in the exercise</li> <li>• Absence of standard process and protocols for implementing EE projects</li> </ul>

Continued consultation with various stakeholders at numerous platforms during the preparation of the manual helped in identifying the keys issues and barriers afflicting this sector at large. Various industry players have expressed their dissatisfaction over the pace of the progress and lack of the urgency by the stakeholders in making this sector viable for the long run. Also, various experts' view is that government and public agencies should encourage and invest in upgrading its capacity in designing such projects for municipalities in India. Dedicated financial and human resources should be deployed to fast track the development of this sector in municipalities. This is important when we try to address the barriers (as discussed in the table above). Various ULBs officials also viewed lack of awareness and information about the benefits of EE street lighting as one of the key reason for limited attention. Information and awareness is important to get political and administration's mandate for designing and implementing such programs. In addition, the fact that such improvements will lead to reduction in financial expenditure, better fiscal management, efficient use of infrastructure and enhanced service quality is largely unknown to the policy makers, the program is yet to figure prominently in the policy agenda of the governments. Majority of the ULBs are not financially sound and therefore require the support from state and central government in addressing these barriers. These barriers need to be addressed to define and prepare holistic and comprehensive policy not to just retrofit the streetlights, but also to improve the overall services and infrastructure associated with the municipal street lighting. This will ensure the creation of sustainable infrastructure to help ULBs achieve improved energy performance for a longer period.

# Energy Efficiency Policy and Regulatory Landscape in India

Several policies and institutional initiatives have been introduced by the Government of India (GoI) with a view to encourage EE in the Indian economy. These initiatives have taken form of laws, amendments, legislations and policy frameworks. Collectively these interventions are providing the supporting landscape for achieving EE potential in the country. Application of EE in the street lighting or municipal segments in general, has found support from this landscape.

See Figure 0 and Box 1 for a snapshot of the key policies and legislations in India:



**Figure 0: Policies and Institutions Supporting Energy Efficiency Implementation, India**

### Box 1: Overview of Indian Polices and Regulations for EE

The year 2001 marked a turning point in India's history of energy efficiency and conservation efforts. The year was marked by the enactment of **The Energy Conservation Act, 2001 (EC2001)**, as an important legislative document directing India's efforts at EE in a streamlined manner. The objective of the act is to create and sustain markets for energy efficiency in the country. The act, however, confers regulatory powers to the Central & State Government to enhance energy efficiency in the following sectors:

- a) Energy Intensive Industries
- b) Energy using equipment and appliances
- c) Commercial Buildings

The **Indian Electricity Act (EA 2003)** came into force in June 2003, with the key aim of consolidating laws relating to generation, transmission, distribution, trading and use of electricity; and to reform legislation by "promotion of efficient and environmentally benign policies". The Act mandates efficiency in all aspects of power sector -- generation, transmission and distribution of electricity. In 2005, under Section 3(1) of this Act, the central government notified the National Electricity Policy (NEP) for the development of country's power sector based on optimal utilization of resources. NEP puts additional emphasis on higher efficiency levels of power generating plants, stringent measures against electricity theft, promoting energy conservation measures, and boosting renewable energy sources. NEP has accorded high priority to demand-side management (DSM) and has made periodic energy audits compulsory for energy intensive industries. The focus is also on labelling of appliances and high efficiency pumps in agriculture. NEP has also made suggestions for load management and differential tariffs and emphasized encouraging and promoting ESCOs. These initiatives are being implemented by BEE.

More recently, in order to create an organized approach to tackling the challenge of climate change through effective governance in India, the GOI released the **National Action Plan on Climate Change (NAPCC)** in 2008. The NAPCC consists of 8 key national missions to guide the country through the climate change challenge. Amongst the 8 missions, two missions of **National Mission on Sustainable Habitat (NMSH)** and **National Mission on Enhanced Energy Efficiency (NMEEE)** are focussed on achieving energy efficiency in the relevant sectors. NMSH aims to make the habitat sustainable through enhancement of EE in buildings, effective solid waste management, and modal shift to public transport.

The NMEEE on the other hand promotes innovative policy and regulatory regimes, financing mechanisms and business models for achieving EE in the national economy. It has four key programs to support the Mission mandate. These include:

- *Perform, Achieve & Trade (PAT)*: PAT scheme incentivizes energy intensive large industries and facilities (by providing them with tradable certificates of energy savings) for enhanced EE, through technology upgrade & improvement in process.
- *Market Transformation for Energy Efficiency (MTEE)*: Accelerating the shift to energy efficient appliances in designated sectors through innovative measures that make the products more affordable.
- *Framework for Energy Efficient Economic Development (FEEED)*: Developing fiscal instruments to promote energy efficiency.
- *Energy Efficiency Financing Platform (EEFP)*: A mechanism to finance DSM programs in all sectors.

The NMEEE currently, is proving to be the key driver for EE efforts in the country. Amongst other sectors, which are the focus and beneficiaries of the Mission, the Municipal Demand Side Management is increasingly gaining from the mission mandates and programs. The urban local bodies are increasingly taking a lead in creating energy efficient infrastructure for sustainable urbanization in the country. More specifically, the EE initiatives in the Street Lighting sector will gain from the creation of fiscal instruments, financing mechanisms and DSM programs being designed and implemented under the missions.

# 1 OVERVIEW OF ENERGY-EFFICIENT STREET LIGHTING

Street lighting is one of most critical elements of urban infrastructure. It is a key service that public authorities need to provide for ensuring adequate lighting on the road, which leads to enhanced safety and security in the city, apart from improving visibility during evenings and night. The use of energy-efficient technologies has the potential to save costs because of reduction in electricity consumption.

## 1.1 Components of Energy-Efficient Street Lighting

All streetlights in India need to conform to the National Lighting Code, where the minimum intensity of light on various kinds of roads has been defined. The roads have been categorized based on traffic density. All public lighting infrastructure must conform to these standards. Based on the lighting requirements as well as the age of the existing lighting infrastructure a decision is made on whether a new design and installation is required or objectives could be met by retrofitting the existing lighting system.

The components of a lighting system are classified based on their functions. They are generally described as:

- **Structural systems:** consisting of poles and pole bases (foundations)
- **Optical systems:** which consists of the luminaires
- **Electrical systems:** consisting of lamps, ballasts and service cabinets (fuse box)

During designing, these systems should be designed as per the road requirements in a way to achieve minimum life-cycle cost, while meeting lighting requirements. To achieve an effective energy-efficient design, it is essential to select the proper lamp/ballast combination that produces high lumens per watt together with fixtures that meet design requirements and minimize glare, light trespass and light pollution.

### 1.1.1 *Structural Systems: Poles*

Based on the purpose and lighting requirement of the roadway, as well as the age of existing lighting infrastructure, decisions have to be taken upon whether new designs and installations of street lighting is required or whether project goals can be accomplished by retrofitting the existing lighting system.

To retrofit the existing system, it must be determined whether existing poles can be used with replacement of only luminaires, or if the ground needs to be dug up for laying cables.

In case of new installation, exact location and number of poles needs to be decided.

### 1.1.2 *Optical Systems: Luminaires*

Lighting EE is a function of both the light source (the light “bulb” or lamp) and the fixture, including necessary controls, power supplies, other electronics, and optical elements. A luminaire is defined as a complete unit consisting of a lamp, together with the parts designed to distribute the light, to position and protect the lamp, and to connect the lamp to the power supply. Components that make up a luminaire include the reflector, the refractor, and the housing. These are important to ensure luminaire efficiency and cut-off and glare control, to guarantee the right level of lighting while avoiding light pollution. The Indian BIS standards provide specifications for selection of street lighting luminaires.

Luminaires are classified into three categories according to the degree of glare (BIS 1981).

**Cut-off luminaire:** A luminaire whose light distribution is characterized by rapid reduction of luminous intensity in the region between about 80° and the horizontal. The direction of maximum intensity may vary but should be below 65°. The principal advantage of the cut-off system is the reduction of glare.

**Semi-cut-off luminaire:** A luminaire whose light distribution is characterized by a less severe reduction in the intensity in the region of 80° to 90°. The direction of maximum intensity may vary but should be below 75°. The principal advantage of the semi-cut-off system is a greater flexibility in siting.

**Non-cut-off luminaire:** A luminaire where there is no limitation on light distribution at any angle. This luminaire is permissible when a certain amount of glare may be accepted (when daytime appearance of the street is important) and when the luminaires are large and have reduced brightness.

### **1.1.3 Electrical Systems: Lamps and Ballasts**

#### **1.1.3.1 Lamps**

The most important component of any street lighting system is its light source. It is the principal determinant of the visual quality, cost, and EE aspects of the illumination system. An electric light source is a device, which transforms electrical energy, or power (in watts), into visible electromagnetic radiation, or light (lumens). The rate of converting electrical energy into visible light is called "luminous efficacy" and is measured in lumens per watt. Today, street lighting commonly uses high-intensity discharge lamps, often HPS high pressure sodium lamps. However, lamp technologies have greatly evolved over the years, with increasing EE potential. Details on types of lamp technologies along with their selection will be discussed in upcoming sections in the manual.

#### **1.1.3.2 Ballasts**

Ballasts are required for all HID and fluorescent lamps. The ballast generally serves three functions. First, it provides the proper open circuit voltage to start the lamp. Second, it keeps the lamp operating within its design parameters. Third, it adapts the lamp to any one of the line voltages commonly available.

Sodium vapor and metal halide lamps require an igniter to initiate the arc in the lamps. High frequency electronic ballasts are recommended for tubular fluorescent lamps in street lighting in order to optimize energy use and to avoid flickering during low voltage conditions at peak traffic hours. Another useful technology to save energy in HPSV and MH lamps is the new dimmable electronic ballast that enables both constant wattage and variable illumination. The advantage of this ballast is the maintenance of desired lux level (illumination level) during low and high voltage periods at night, which helps ensure good visibility for road users during peak traffic hours. In addition, capacitors and igniters are not required when using this technology, which brings down the maintenance costs.

### **1.1.4 Features of Effective Street Lighting Systems**

In order to properly design new lighting schemes, it is important to consider the appropriateness and effectiveness of the various energy-efficient street lighting technologies and systems for different situations. Street lighting technology and design decisions should be based on meeting local lighting requirements and design as well as technical specifications of the NLC, while achieving maximum EE. Parameters, such as the lamp efficacy, CRI, power factor, and operating temperature, also play an important role and should be taken into consideration while taking decisions about the lighting system.

Table 1.1 lists the important features to consider when designing and procuring an energy-efficient street lighting system.

**Table 1.1: Key Features of Effective Energy-Efficient Street Lighting Systems**

S. No.	Features	Benefits
1	Proper pole height and spacing	Provides uniform light distribution, which improves appearance for safety and security Meets recommended light levels Minimizes the number of poles, reducing energy and maintenance costs
2	Proper luminaire aesthetics	Blends in with the surroundings
3	High lamp efficacy and luminaire efficiency	Minimizes energy cost
4	Life of the luminaire and other components	Reduces lamp replacement costs
5	Cost effectiveness	Lowers operating cost
6	High lumen maintenance	Reduces lamp replacement costs
7	Good color rendering	Helps object appear more natural and pleasing to the public Allows better recognition of the environment, improves security
8	Short lamp restrike	Allows the lamp to quickly come back after a power interruption
9	Proper light distribution	Provides required light on the roads and walkways
10	Proper cut-off	Provides adequate optical control to minimize light pollution
11	Minimizing light pollution and glare	Reduces energy use
12	Automatic shutoff	Saves energy and maintenance costs by turning lamps off when not needed

Source: NYSERDA 2002.

## 1.2 Standards Relevant for Street Lighting

### *Indian Standards*

In order to ensure the **citizens'** safety and provide guidance to the public lighting authorities the Bureau of Indian Standards (BIS) has established standards (IS 1944) for lighting levels for street light. The Indian Standard (BIS 1981) has classified the roads based on traffic density of the road (Table 1.2). BIS also provides specifications for Street Lighting Poles (Table 1.3) and recommends mounting height of luminaires and levels of illumination (Table 1.4).

**Table 1.2: Classification of the Roads**

Group	Description
A1	For very important routes with rapid and dense traffic where the only considerations are the safety and speed of the traffic and the comfort of drivers
A2	For main roads with considerable mixed traffic like main city streets, arterial roads, and thoroughfares

<b>B1</b>	For secondary roads with considerable traffic such as local traffic routes, and shopping streets
<b>B2</b>	For secondary roads with light traffic
<b>C</b>	For residential and unclassified roads not included in the previous groups
<b>D</b>	For bridges and flyovers
<b>E</b>	For towns and city centers
<b>F</b>	For roads with special requirements such as roads near airports, and railways

Source: BIS 1981.

**Table 1.3: Specifications for Street Lighting Poles**

Section	Overall length 11 m + 25 mm (base plate)			Overall length 9.5 m +25 mm (base plate)		
	Outside Diameter (mm)	Thickness (mm)	Length (mm)	Outside Diameter (mm)	Thickness (mm)	Length (mm)
Bottom section	139.7	4.85	5600	165.1	4.85	5000
Middle section	114.3	4.5	2700	139.7	4.5	2250
Top section	88.9	3.25	2700	114.3	3.65	2250
Planting depth	1800 mm			1800 mm		
Nominal weight of the pole	160 kg			147 kg		
Tolerance on mean weight for bulk supply is 7.5 %						
Tolerance for single pole weight is 10%						

Source: BIS 1981.

**Table 1.4: Recommended Levels of Illumination and Mounting Height of Luminaires**

Type of Road	Road Characteristics	Average Level of Illumination on Road Surface in Lux	Ratio of Minimum/Average Illumination	Type of Luminaire Preferred	Min: Max (%)	Mounting Height of Luminaires
A-1	Important traffic routes carrying fast traffic	30	0.4	Cut-off	33	9 to 10 meters
A-2	Main roads carrying mixed traffic like city main roads/streets, arterial roads, throughways	15	0.4	Cut-off	33	9 to 10 meters
B-1	Secondary roads with considerable traffic like local traffic routes, shopping streets	8	0.3	Cut-off or semi-cut-off	20	7.5 to 9 meters

B-2	Secondary roads with light traffic	4	0.3	Cut-off or semi-cut-off	20	7.5 to 9 meters
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Source: BIS 1981.

It is important for the Indian ULBs to design a street lighting system that does not compromise on the quality requirements and specifications as per the national regulations. It is also important for ULBs to consider the improvement of basic infrastructure when retrofitting projects are designed. The basic infrastructure may include proper brackets, fuse boxes, and grounding systems.

In 2012, the Bureau of Energy Efficiency (BEE) and Bureau of Indian Standards (BIS) introduced 10 comprehensive performance, safety, and quality standards for the LED lighting (Table 1.5) as part of the Government of India (GoI) initiative to introduce and promote energy-efficient street lighting in the country and to introduce the concept of sustainability in the ULBs,<sup>1</sup> although these standards are not specific to the street lighting standards. Thus, Table 1.5 refers to general lighting standards.

In addition, BIS has also issued a National Building Code 2010, as a guidebook on comprehensive source for lighting projects for various applications in the country. The guidebook has specific sections on Road Lighting and Energy-Efficient Lighting Systems. The ULBs and project design consultant may refer to the code, for reference with respect to the project design of street or public lighting system.

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<sup>1</sup><http://www.theclimategroup.org/what-we-do/news-and-blogs/india-announces-critical-standards-on-led-lighting/>, last accessed on December 2014.

**Table 1.5: BIS LED Lighting Standards***Source:* BIS 2012.

S. No.	Standards Title	Indian Standards	International Standards
1	Terms and Definition	IS 16101:2012	IEC 62504 TS
2	Self-ballasted LED lamps for general lighting services Part 1, Safety Requirements	IS 16102 (Part 1):2012	IEC 62560
3	Self-ballasted LED lamps for general lighting services Part 2, Performance Requirements	IS 16102 (Part 2):2012	IEC 62612
4	LED modules for general lighting— Safety Specifications	IS 16103(Part1)	IEC 62031
5	LED modules for general lighting Part 2, Performance Requirements	IS 16103(Part2)	IEC 62717
6	DC- or AC-supplied electronic control gear for LED modules—Performance Requirements	IS 16104:2012	IEC 62384
7	Method of measurement of lumen maintenance of solid state light (LED) sources	IS 16105:2012	LM 80
8	Electrical and Photometric Measurements of Solid-State Lighting Products	IS 16106:2012	LM 79
9	LED luminaires for general lighting purposes part 1, safety requirements	IS 16107(Part 1)	34D/950/NP
10	LED luminaires for general lighting Part 2, Performance requirements	IS 16107(Part 2)	34D/977/DC
11	Photo biological Safety of LED and LED systems	IS 16108:2012	IEC 62471

### **International Standards**

The Commission Internationale de l'Éclairage (CIE) is one of the main international entities providing standards and guidelines for street and outdoor lighting, particularly roadway lighting. Standard CIE 115-1995 highlights the importance and purpose of street and outdoor lighting in:

Allowing users of vehicles to proceed safely, leading to fewer accidents and fatalities

- Facilitate high visibility among pedestrians so they can commute safely
- Substantial reduction of criminal activities, leading to a sense of security among residential communities.

Above factors have largely affected the design and installation standards in outdoor lighting since 1976. Examples of international standards and guidelines applicable for street and outdoor lighting and traffic lighting include:

CIE 31-1976—Glare and Uniformity in Road Lightings Installations  
 CIE 22-1977—Depreciation of Installation and their Maintenance (in Road Lighting)  
 CIE 47-1979—Road Lighting for Wet Conditions  
 CIE 48-1980—Light Signals for Road Traffic Control  
 CIE 66-1984—Road Surfaces and Lighting (Joint Technical Report CIE/PIARC)  
 CIE 93-1992—Road Lighting as an Accident Countermeasure  
 CIE 132-1999: Design Methods for Lighting of Roads  
 CIE 140-2000: Road Lighting Calculations  
 CIE 136-2000: Guide to the Lighting of Urban Areas  
 CIE 144-2001: Road Surface and Road Marking Reflection Characteristics  
 CIE 115-2007: Recommendations for the Lighting of Motorized Traffic (updated)  
 CIE 180-2007: Technical Report: Road Transport Lighting for Developing Countries  
 CIE 115-2010: Lighting of Roads for Motor and Pedestrian Traffic  
 CIE 119-2010: Recommended System for Mesopic Photometry Based on Visual Performance

Other International/Economy-Wide Standards of reference include:

CEN/TR 13201-1: Road Lighting—Part 1: Selection of Lighting Classes  
 EN 13201-2 Road: Lighting—Part 2: Performance Requirements  
 ANSI/IESNA RP-8-00: American National Standard Practice for Roadway  
**ANSI C136.37: Solid-State Light Sources Used in Roadway and Area Lighting**  
 AS/NZS 1158.1/1-1997: Road Lighting—Vehicular Traffic Lighting  
 AS 1158.2-1971: Standards Association of Australia (SSA) Public Lighting Code—Lighting of Minor Streets  
 AS CA19-1939: Australian Standard Rules for Street Lighting

ANSI C136.37 is the only international standard focusing exclusively on LED Street and outdoor lighting. The standard specifies a number of requirements for LED luminaires based on existing regional and international LED standards such as operating temperature, correlated color temperature, mounting provisions, dimming, ingress protection, wiring and grounding. The standard aims at providing

recommendations and guidance to utilities and manufacturers.

The People’s Republic of China, Chinese Taipei, Republic of Korea and the United States are the only APEC member economies with economy-wide standards covering specifically LED street and outdoor lighting applications.

### 1.3 Types of Lamp Technologies

Various types of lamp technologies are prevalent in the market today. These technologies greatly vary in their luminous efficacy, color rendering properties, and lamp life. A brief description of types of lamp technologies currently available is provided in Table 1.6 below. Today, street lighting commonly uses high-intensity discharge lamps, often HPS high pressure sodium lamps.

**Table 1.6: Types of Lamp Technologies**

Type of Lamp	Luminous Efficacy (lm/W)	Color Rendering Properties	Lamp life in hrs.	Remarks
High Pressure Mercury Vapor (MV)	35-36 lm/W	Fair	10000-15000	High energy use, poor lamp life
Metal Halide (MH)	70-130 lm/W	Excellent	8000-12000	High luminous efficacy, poor lamp life
High Pressure Sodium Vapor (HPSV)	50-150 lm/W	Fair	15000-24000	Energy-Efficient, poor color rendering
Low Pressure Sodium Vapor (LPSV)	100-190 lm/W	Very Poor	18000-24000	Energy-Efficient, very poor color rendering
Low Pressure Mercury Fluorescent Tubular Lamp (T12 & T8)	30-90 lm/W	Good	5000-10000	Poor lamp life, medium energy use, only available in low wattages
EE Fluorescent Tubular Lamp (T5)	100-120 lm/W	Very Good	15000-20000	EE, long lamp life, only available in low wattages
Light Emitting Diode (LED)	70-160 lm/W	Good	40000-90000	High energy savings, low O&M, long life, no mercury, high capital cost and evolving technology.

Source: USAID 2010.

Street lighting installations normally use one of three types of high intensity discharge (HID) lamps: high-pressure sodium vapor (HPSV), metal halide (MH), or mercury vapor (MV). HSPVs produce a yellowish light, have a long life, are very energy-efficient, and have a consistent lumen intensity over a long period, but they have poor color-rendering properties. MH lamps are the most frequently used as an alternative to HPSV in new installations. They are also quite efficient and provide much better color rendering. However, these lamps tend to have a shorter lamp life (some models below 10,000 hours) and poor lumen maintenance over the life of the lamp. Recent developments have shown improvements in these areas, but the improved lamps are presently limited in supply and higher in cost. MV lamps are the least efficient of the HID types and have poor lumen maintenance.

Currently in the urban street lighting space, HPS technology is predominant in India. However, HPS lamps are generally regarded as being inappropriate for night lighting. Because of a reflector attached behind the lamp of an HPS, much of the luminance of the light is lost. This also produces light pollution in the surrounding area, which leads to inconvenient glare for drivers and pedestrians and this may cause roadways hazard.

Light-emitting diode (LED) technology is a fast-evolving technology with significant energy-saving potential. Operating for an average of 10 hours per day, LEDs have a life span of up to 13 years, and provide a pleasant spectrum of light (Masthead LED Lighting 2009). The lifetime and performance depends on quality of the LED, system design, operating environment, and other factors such as the lumen depreciation factor over a period of time.

Although the upfront cost of the LED is higher than the cost of most HID lamps, the energy consumed **by the LED is half of the lamp's energy (or less) and LEDs** last longer than conventional lamps, resulting in significant savings. The LED fixture does not require ballast or a capacitor; instead it converts the supply voltage to low voltage direct current, using a small electronic power supply.

The LEDs or induction light, emit a white light that provides high levels of scotopic lumens allowing streetlights with lower wattages and lower photopic lumens to replace existing streetlights. For instance, a 30 W LED street light can replace a 70 W HPS lamp, while providing the same illumination (GRAH Lighting 2012). This ultimately results in significant energy savings. Under optimal conditions, LED can reduce energy by up to 60%. Further EE gains can be achieved by combining LED with adaptive monitoring and control technologies. While adaptive lighting can be too demanding for some cities at this stage, there are some easy options to reduce energy demand such as installing a timing meter, to switch lamps at some point of time. For instance, Semarang switches off major parts of its street lighting after 1 am. However, it should be carefully evaluated whether this is an effective measure with respect to crosscutting issues like security on the roads (World Bank 2007). Given that street lighting represents a significant share **of a city government's budget for electricity application, LED street lighting presents** an opportunity for becoming more energy-efficient and cost effective. The Table 1.7 highlights the advantages and disadvantages of different lamp technologies.

**Table 1.7: Fixture Technology Options for Street lighting**

Technology	Mercury Vapor	High Pressure Sodium Vapor	Induction	New Ceramic	LED
Relative Age	Oldest ←————→ Newest				
Description	Older, Very Common white light HID technology	Most common HID light source used in street lighting	White light electrode less light source with long operating life	White light HID technology; new CMH fixtures are >35 more efficient than previous CMH	White-light, directional, solid-state light source
Pros	<ul style="list-style-type: none"> <li>-Low initial cost</li> <li>-Longer lamp life</li> <li>-White light</li> <li>-Sudden failure are uncommon</li> </ul>	<ul style="list-style-type: none"> <li>-Low initial cost</li> <li>-Longer lamp life</li> <li>-High lamp efficacy (70-150 lumens/watt)</li> </ul>	<ul style="list-style-type: none"> <li>-Virtually maintenance-free operations</li> <li>-High efficacy 60-70+ lumens/watts</li> <li>-Excellent color rendering index 80-90 +</li> <li>-Choice of warm white to cool white (2,700-6,500 K)</li> <li>-Instant start and restrike operations</li> <li>-No flickering, strobing, or noise</li> <li>-Low temperature operations</li> </ul>	<ul style="list-style-type: none"> <li>-White light</li> <li>-Longer lamp life</li> <li>-High lamp efficacy (115 lumens/watt)</li> <li>-High fixture efficiency</li> </ul>	<ul style="list-style-type: none"> <li>-Small size</li> <li>-Physically robust</li> <li>-Very long time life expectancy</li> <li>-Switching has no effect on life, very short rise time</li> <li>-Contains no mercury</li> <li>-Excellent low ambient temperature operations</li> <li>-High lumens efficacy (LEDs are evolving rapidly and range varies)</li> <li>-New luminaire design possible</li> <li>-Possibility to change colors</li> <li>-Instant start and restrike operations</li> <li>-No flickering, strobing or noise</li> <li>-No optical heat on radiation</li> </ul>
Cons	<ul style="list-style-type: none"> <li>-Poor lamp efficacy (34-58 lumens/watt)</li> <li>-Low fixture efficiency</li> <li>-Contains mercury</li> </ul>	<ul style="list-style-type: none"> <li>-Low CRI</li> <li>-Contains mercury</li> </ul>	<ul style="list-style-type: none"> <li>-High initial cost</li> <li>-Low lamp efficacy (36-64 lumens/watt)</li> <li>-Contains mercury</li> </ul>	<ul style="list-style-type: none"> <li>-High price</li> <li>-Lower luminaire efficacy than LED</li> <li>-Higher electricity consumption than LED</li> <li>-Contains mercury</li> <li>-Lacks standardization</li> </ul>	<ul style="list-style-type: none"> <li>-High price</li> <li>-Low luminous flux</li> <li>-CRI can be low</li> <li>-Risk of glare from the high output with small lamp size</li> <li>-Need for thermal management</li> <li>-Lacks standardization</li> </ul>

### **1.3.1 Types of Lamp Technologies**

Since the first commercially available LEDs in 1960, the technology has been constantly improving. **Today's LEDs cover spectral emissions from the red to yellow region of the visible spectrum. White LEDs** can be realized by mixing the emission of different colored LEDs or by the utilization of phosphors. Depending on the properties of the phosphor layers utilized, white light of different qualities can be realized. Electrically, an LED is characterized by its forward current and forward voltage. Because of their typical characteristic of representing the forward current as a function of the forward voltage, LEDs are called current-controlled devices.

The electrical and optical performance of an LED is interrelated with its thermal characteristics. Because of the inefficiencies resulting from the imperfections in the semiconductor and in the LED package structure, heat losses are generated. These losses have to be removed from the device in order to keep the operation temperature below the maximum allowed and avoid premature failure of the device. The heat losses are firstly conducted to the exterior of the LED package throughout an included heat slug. Next, the heat is realized to the ambient throughout convection and radiation. In some applications the utilization of an exterior cooling system such as a heat sink is required to facilitate the release of the heat to the ambient (Halonen and others, p. 114).

*Maturity:* Based on an average operation of 10 hours per day, LEDs have a life span of up to 13 years (Masthead LED Lighting 2009). The lifetime and performance depends on quality of the LED, system design, operating environment, and other factors such as the lumen depreciation factor over a period of time.

*Efficiency:* Although the upfront cost of the LED is 2-4 times more than the cost of most high-intensity **discharge (HID) lamps, the energy consumed by the LED is half of the conventional lamp's energy (or less)** and LEDs last longer than conventional lamps, resulting in significant savings. The LED fixture does not require ballast or a capacitor; instead it converts the supply voltage to low voltage direct current, using a small electronic power supply. Average annual maintenance cost is two times lower than that of Mercury or HPS lamps (GIZ PAKLIM 2012).

*Environmental Impact:* The U.S. Department of Energy (DOE) explored the environmental impacts of LEDs in comparison to incandescent and CFL lamp types. Hereby the lighting production process, used raw materials, recycling options and required energy resources have been taken into account. It was observed that the currently produced LEDs had a significantly lower environmental impact than the incandescent, and a slight edge over the CFL. The only downside of LEDs is the waste landfill because **of the lamp's large** aluminum heat sink. It is expected that this impact will decrease because of efficiency improvements and recycling efforts in the near future (Kinzey and Myer 2013).

### **1.3.2 Magnetic Induction Lighting**

The burning time of discharge lamps is normally limited by abrasion of electrodes. It is possible to avoid this characteristic by feeding electrical power into the discharge inductively or capacitatively. Hence, induction lighting is essentially a fluorescent light without electrodes or filaments, the items that frequently cause other bulbs to burn out quickly (Kinzey and Myer 2013). The filling of the discharge vessel consists of mercury (amalgam) and low pressure krypton. Like in fluorescent lamps, the primary emission (in UV-region) is transformed with a phosphor coating into visible radiation (Halonen and others, p.105).

*Maturity:* Many induction lighting units have an extremely long lifetime of up to 100,000 hours. To put this in perspective, an induction lighting system lasting 100,000 hours will last more than 11 years in continuous 24/7 operation, and 25 years if operated 10 hours a day. Some manufacturers only rate their ballasts for 60,000 hours, even though the bulb may last longer (Kinzey and Myer 2013).

*Efficiency:* A long lamp life and good lumen maintenance can be achieved with these lamps because of the absence of electrodes. The operation is virtually free of any maintenance of the electrical

components. However investment costs are significantly higher than for HPS or Mercury lamps. A study conducted by the U.S. Department of Energy shows installation and equipment costs of induction lamps in the range of LEDs. Energy consumption for generating similar illumination is higher than for LEDs (DOE 2012).

*Environmental Impact:* As standard fluorescent bulbs, induction bulbs contain a small amount of mercury, although it is in a solid state that makes it less harmful in case of breakage. Nonetheless, disposal of induction bulbs has to be done responsibly at the end of their service life because of the mercury content (Kinzey and Myer 2013).

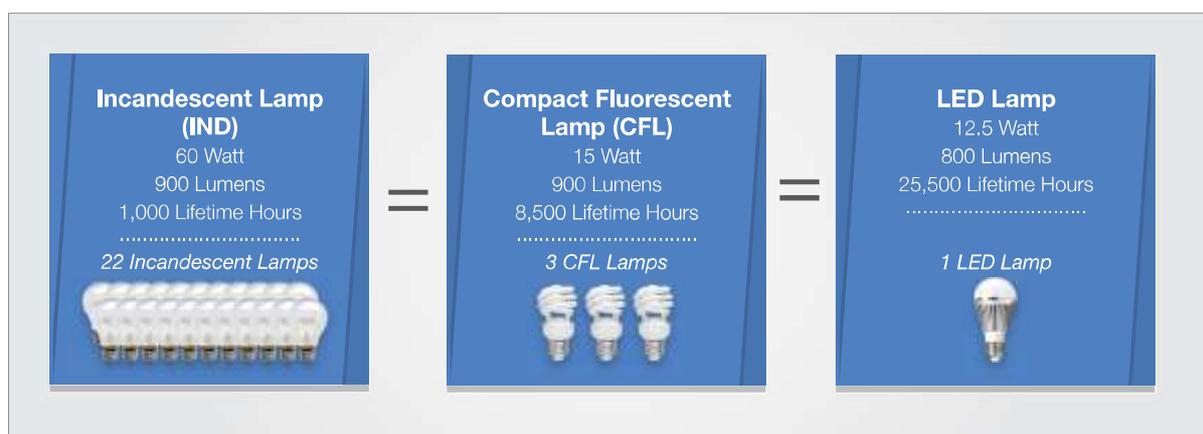
### 1.3.3 Life Cycle Analysis of the LEDs

LED did bring about a revolution in the space of the street lighting sector, where it is showing remarkable improvement every generation in its efficacy, efficiency, and lumens. According to the comprehensive study conducted by the U.S. Department of Energy (DOE), there are key findings with respect to the different technologies' life cycle analysis (LCA). This provides insight for the policy makers to focus on the future trends to have maximum optimization from its street lighting sector.

LED lighting has the potential to save energy and improve lighting quality and performance beyond that of many conventional lighting technologies. However, in order to develop an energy use comparison for LED, CFL and incandescent lamps, it is necessary to estimate the life-cycle energy consumption of these three light technologies.

The key results of the DOE analysis indicate that average life-cycle energy consumption of LED lamps and CFLs are similar, at approximately 3,900 MJ per functional unit (20 million lumen-hours). This is about one quarter of the incandescent lamp energy consumption—15,100 MJ per functional unit. This has put LED and CFL technology at par on the basis of 2011 data. In addition, by 2015, if LED lamps meet their performance targets, its life-cycle energy use are expected to decrease by approximately one half. This gives decision maker suggestion that LED technology is evolving very quickly and soon as per the LCA it will be most efficient technology. Adaptation of the LEDs in the street lighting space will prepare our infrastructure for the future technology (DOE 2012).

**Figure 1.1: Number of lamps needed to supply 20 Million Lumen-hours**



Source: DOE 2012.

As shown in Figure 1.1, since the incandescent lamp has a lumen output of 900 lumens and an operating lifetime of 1,000 hours one would need twenty-two lamps to provide 20 million lumen-hours of lighting service. Similarly for a CFL with an output of 900 lumens and an operating lifetime of 8,500 hours one would need three lamps. All energy consumption values presented are in terms of the energy needed to supply 20 million lumen-hours of lighting service.

## 1.4 Building Intelligent Street Lighting Systems

Street lighting systems are not complete solution, if not integrated with automation and other intelligent features. Generally, it has been observed that an integrated smart street lighting system provides over 30 % of extra energy savings. Also, it provides the O&M service provider with better control over the quality of the services. It gives municipality better, dynamic remote management and faster outage response. This also helps them immensely in reducing their O&M costs over time.

### ***Business Case for Intelligent/Smart Street Lighting System***

Intelligent street lighting systems benefits can categorized in two ways: energy savings and operational savings.

Energy Savings: Typically LED or other modern street lighting system with automation has biggest benefits of lower energy costs which results from following features-

- Low wattage: LEDs provide significant energy savings by delivering the same or enhanced quality light at lower wattages than legacy bulbs.
- Dimming: Because of their high light output, LED lamps can be dimmed as much as 50 percent when first installed with minimal compromise in light output. In addition, operators can schedule lamps to dim as circumstances allow, such as at low traffic times or in unpopulated areas in the middle of night. The city of Brittany, France, for example, dims its streetlights by 60 percent between 11 p.m. and 5 a.m. to save energy.
- Reduced burn time: With on/off scheduling capabilities, operators can easily modify street light operation to coincide with changing sunrise/sunset times, reducing lamp burn time.

Operational Savings: The operational savings from networked LEDs will vary depending on the costs the street light operator currently incurs to maintain their lights.

- Long life: LED lamps last 3 to 4 times longer than legacy lamps, so require replacement less often, which reduces hardware and installation costs.
- Remote monitoring and management: Street light management software gives operators visibility into street light operations (for example, how much energy a lamp is using), as well as control over dimming and on/off schedules, reducing the need to run lamps for long periods, and deploying photocells.
- Automatic outage detection: Management software provides instant outage notification, dramatically reducing the number of calls (and related costs) to the call center and cutting downtime up to 90 percent. With accurate outage information, operators can eliminate truck rolls from false alarms, pinpoint nonworking lamps and quickly dispatch crews to specific lights.
- Proactive maintenance: These interventions help operator or municipal corporations to provide in time proactive maintenance to the citizen. Also, this results in extra savings for them.

A lot of technological development has made it possible to have centralized automated intelligent street lighting infrastructure in our cities. In Table 1.8, the list of the options that is available with the project consultant or ULBs to further enhance the quality of street lighting systems and gain further savings from the intelligent system in place. This also ensures that grievance redress mechanism is efficient and helps to reduce cost of O&M in the systems.

While designing the solutions for the street lighting infrastructure, ULBs and the experts should look at the financial viability of the CMC solutions, since some of solutions may not be commercially viable for the small or midsize projects. The solutions proposed should be critically examined to ensure sustainability.

**Table 1.8: Proposed Automation and Energy Savings Systems**

	Purposed Automation	Purpose	Benefits
<b>Solution 1</b>	Dimming in off peak hours	Reducing the lux level as per the requirement of the outdoor lighting conditions	It Will result in extra savings through adjustable lux level
<b>Solution 2</b>	Lighting automation with astronomical time switch control	Automatic switch to on-off the lighting feeder	It will reduce the human errors and mistake and will reduce the wastage. Also, will reduce the O&M cost
<b>Solution 3</b>	Astronomical time-switch control-based lighting automation with flux stabilizers with astronomical control		
<b>Solution 4</b>	Astronomical time switch-based automation with remote control using GSM technology	This will lead to the establishment remote monitoring	Centralized monitoring system can be set up over this technology, which will lead to more effective and responsive O&M.
<b>Solution 5</b>	A combination of solutions 3 and 4	This will lead to the establishment remote monitoring	Centralized monitoring system can be set up over this technology, which will lead to more effective and responsive O&M.
<b>Solution 6</b>	Wireless controls	Both these technology will result in having smart real time intelligent street light system, which will help in reducing O&M cost and be effective.	
<b>Solution 7</b>	GSM/GPRS-based controls		

Source: Author.

## 1.5 Key Steps towards Implementing Energy Efficiency Street Lighting Projects

Having discussed the technical aspects of energy-efficient lighting in streets, this section highlights the key steps involved in implementing EE in streetlights (Figure 1.2). These steps are discussed in detail in the following sections of the manual.

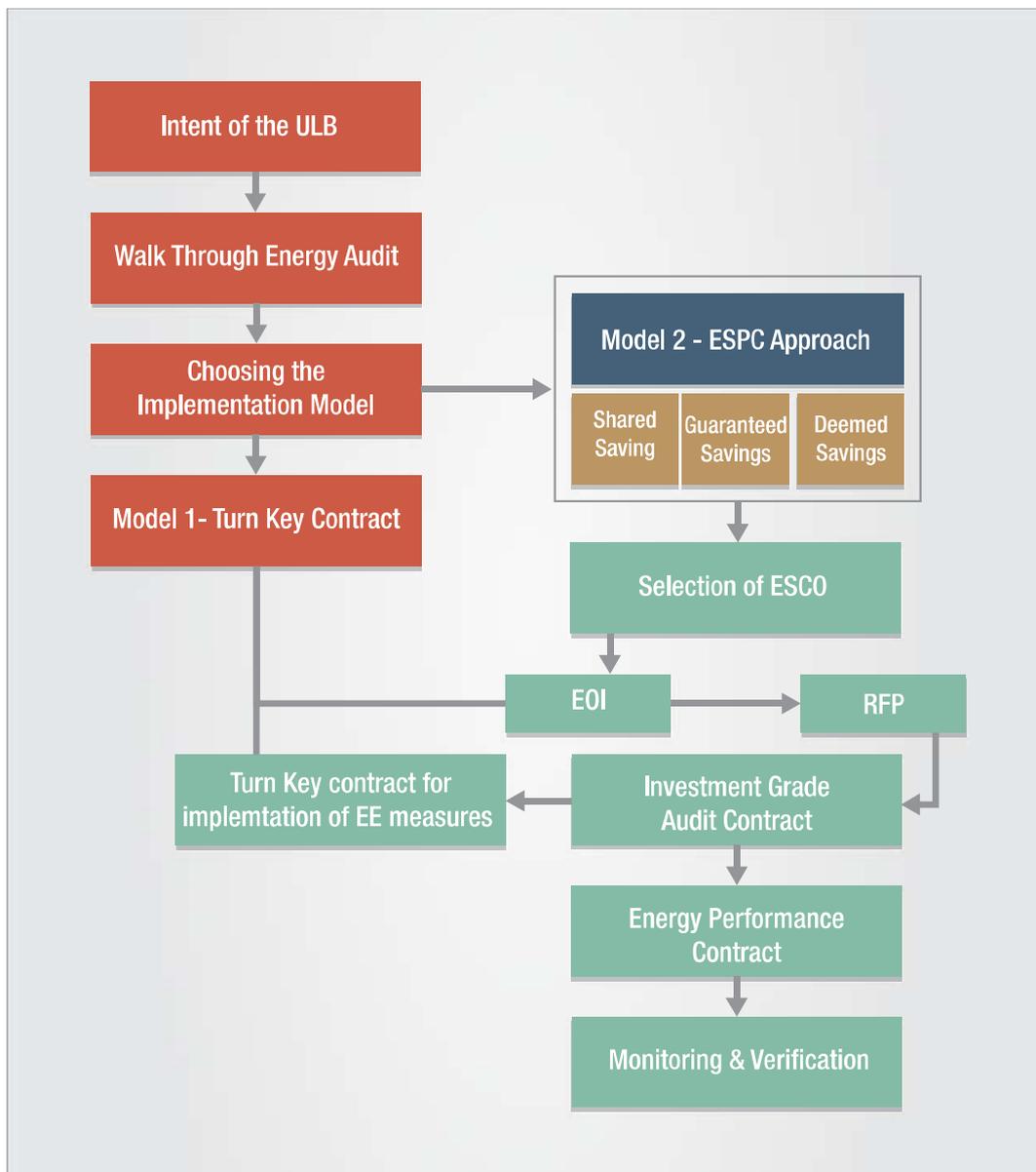


Figure 1.2: Steps in Implementing EE Street Lighting Projects

## 2 IMPLEMENTATION MODELS FOR STREET LIGHTING PROJECT

Having established the need for an EE Street Lighting project, the immediate next step for the municipality is to determine the implementation model for the project. The implementation models for the EE street lighting projects largely vary by the type of financing models chosen. The primary financing options available for project proponents to finance EE projects are via internal funding through capital budgets, debt financing (mostly loans and lease) and via energy performance contracts (shared and guarantee savings). The Municipal EE street lighting project implementation can be financed in three ways:

- The municipality uses its internal funds such as O&M budget and capital budget
- The municipality borrows from financial institutions
- The Energy Saving Company (ESCO) brings the finance and implements agreed upon energy saving measures.

This section of the manual focuses on two main models of implementation, where the second model can be further classified into three variants based on the energy savings sharing mechanism.

**Model 1:** Municipality procuring finance from a financial institution to contract with an ESCO or Energy Audit firm to implement the Energy Efficiency Project on a turnkey basis.

**Model 2:** *Public-Private Partnership-based Models- ESPC approach* (ESCO financing the Energy Efficiency Project implementation under an Energy Performance Contract).

- 2.1: Shared Saving Model
- 2.2: Guaranteed Savings Model
- 2.3: Annuity-Based Deemed Saving Model

These models largely vary based on the type of financing and sharing of energy savings. The steps involved in implementing EE street lighting projects, remains the same. What varies model by model is the kind of documentation required and entity performing each step. Each of the steps as identified in the previous section of the manual is described in the succeeding sections ahead.

Globally, different countries are experimenting and employing innovative models to finance and implement EE street lighting projects. Some of the innovative models that are being designed or executed to implement street lighting projects are presented in Box 2.

## **Box 2: Key street lighting innovative implementation models**

### **1. Brazil CCIP Tax and Street Lighting Innovations**

Arguably, the most important federal regulation for public street lighting is the establishment of the tax to fund public lighting services, CCIP (Contribuição para o Custeio do Serviço de Iluminação Pública). CCIP is collected for the exclusive purpose of funding public street lighting services, thereby bringing a reliable source of revenue to fund the operation of this sector without the need to rely on the municipal budget approval process. In Belo Horizonte, CCIP is collected as a line item on end-users electricity bills by CEMIG D, the local electricity distribution utility. CCIP revenues make up part of SUDECAP's annual budget.

The purpose of CCIP is to fund electricity expenditures as well as the maintenance, installation and improvement of public lighting equipment. According to municipal legislation, surplus CCIP revenues may also be allocated to PPP projects regarding energy efficiency, renewable energy sources and public lighting technology improvement, among other purposes. Regardless of the model used to implement the project, it is very likely that CCIP will be used as earmarked revenue to repay the upfront cost of the Project. However, due to the volatility associated with CCIP revenues, the city may need to backstop CCIP funds with a guarantee.

### **2. Kenyan National Funding for Public Street Lighting Program**

The key recommendation in the street and public lighting sector is the implementation of an LED lighting program in the County. The County Government currently spends KSh 360 million on electricity, and KSh 280 million on operation and maintenance of public lighting, which consists of 22,000 streetlights and 7,336 public lights. An LED retrofit program would result in savings ranging from KSh 200 million to KSh 330 million per year. Beyond the attractive financial results, the County Government sees the program as a very important way to improve safety and security in the streets, and encourage economic activity. Safety and security is not only critical at the Nairobi city county level, but at the national level as well.

The institutional and regulatory framework in place is sufficient to support the implementation of an LED lighting program. Additional capacity building would be needed for the maintenance of LED lighting. This could be accomplished by bringing in an Energy Service Company. There is need for an investigation into financing mechanism for the project. Options discussed include Public Private Partnership (PPPs), Loans (donor funding), and ESCOs. Vandalism of the physical infrastructure poses a challenge, and solutions need to be explored as well.

### **3. EE Revolving Fund in Western Balkans**

An "EE revolving fund (Fund)" is generally an independent entity established by the government and managed by either an existing entity (e.g., a development bank) or a fund management company (referred to as a Fund Manager) selected by the government through a competitive process. Under either option, the Fund operator is supervised by a board of directors, appointed by the government, which can include both government and nongovernment stakeholders. When a fund manager is engaged, it is recommended using a performance contract, taking into account several factors, such as cost recovery, deal flow, defaults, or customer satisfaction.

Depending on the local market conditions and needs, the Fund may provide a full range of financial services (such as energy auditing, procurement, supervision, and monitoring) as well as financial products such as the following:

- Loans to creditworthy municipalities with sufficient collateral and equity (and sometimes also to other creditworthy enterprises and utilities);
- Energy service agreements (ESAs) to other entities without their own budgets or capacity to implement projects;
- Guarantees for commercial bank loans; and
- ESCO financing and re-financing for public sector EE projects

Regardless of the financing products, repayments are based on the estimated or verified energy cost savings, thereby allowing funds to revolve while the public borrower maintains a positive cash flow. The repayment risk generally rests with the Fund, so some arrangements to secure payments are often made. This could include bundling energy utility payments with the Fund repayment; if the municipality does not pay, the threat exists for a disruption in utility services or possible disconnection.

#### 4. Energy Service Agreements (ESA) in Balkans (Armenia)

Under an ESA, an EE Revolving Fund, ESCO or other EE service provider offers a full package of services to identify, finance, implement and monitor EE projects for clients. The client is usually required to pay all, or a portion of, their baseline energy bill, to cover the investment cost and **associated fees until the contract period ends. ESA payments can also be bundled with a client's energy bills.**

**In this case, the figure on the right illustrates the basic idea of a client's cash flows under the ESA, with payments equal to their baseline energy bill.** In some cases, the contract duration is fixed; in other cases, the contract can be terminated after an agreed level of payment has been made, which can encourage the client to save more energy.

For municipal clients, ESAs are generally not viewed by Ministry of Finance (MOFs) as municipal debt, since they can be viewed as long-term contractual commitments or a form of utility service. If both the client and the Fund are public, public procurement rules may not be required, making financing simpler. This provides a dual advantage to the client of being relatively simple to carrying very little risk.



Before laying out detailed description of the financing models for implementation of EE street lighting projects, it is important to understand the various aspects of energy saving performance contracting (ESPC) approach and defines an Energy Service Company (ESCO).

## 2.1 What Is an ESPC?

A key evolving concept in the EE space is the energy performance contracting approach. An ESPC and ESCO approach was first established in the United States in the late 1970s as a result of energy crisis and the rapid increase in oil prices from the Organization of the Petroleum Exporting Countries (OPEC) oil embargo and the Iranian revolution.

As part of the ESPC approach a range of services related to the adoption of energy-efficient products, technologies, and equipment are provided to **an energy consumer, or “host facility,”** (in case of street lighting, municipalities). Often the services provided can also include financing of the EE upgrades such that the host facility has to put up little or no capital. The payments for the services are made to the ESCO through the money it saves from reduced energy consumption. In many cases, the compensation is contingent on demonstrated performance, in terms of EE improvement or some other measure. Thus, an ESPC approach creates a system where the services and equipment can be paid from the actual energy cost savings.

The ESPC approach can be implemented by organizations such as energy suppliers, equipment manufacturers, vendors, construction management companies, engineering firms, mechanical and electrical contractors, and other related businesses.

The specific approaches to the ESPC vary, they can generally be characterized into two basic types of agreements—“shared savings” and “guaranteed savings” (explained later in the manual). In much of the developed world, these two contracting models remain the most prevalent ones. However since the introduction of ESPC models in the developing countries; there are various variants of the models that are being used to suit the local circumstances (Box 3). An example of a variant of ESPC model, developed indigenously in India is the Annuity-Based Deemed Savings Models in India (explained in detail in later in the manual).

### Box 3: Variants of Different Energy Service Company (ESCO) Business Models

Ranging from the full service/high-risk contracts to low service/risk:

**1. Full-Service ESCO.** The ESCO designs, finances, and implements the project, verifies energy savings, and shares an agreed percentage of the actual energy savings over a fixed period with the customer. This is also referred to as the “shared savings” approach in the United States.

**2. End-Use Outsourcing.** The ESCO takes over operations and maintenance of the equipment and sells the output (e.g., steam, heating/cooling, lighting) to the customer at an agreed price. Costs for all equipment upgrades, repairs, and soon, are borne by the ESCO, but ownership typically remains with the customer. This model is also sometimes referred to as “chauffage,” “contract energy management,” or “energy supply contracting.”

**3. ESCO with Third-Party Financing.** The ESCO designs and implements the project but does not finance it, although it may arrange for or facilitate financing. The ESCO guarantees that the energy savings will be sufficient to cover debt service payments. This is also referred to as “guaranteed savings” in the United States.

**4. ESCO Variable Term Contract:** This is similar to the full-service ESCO, except that the contract term can vary based on actual savings. If actual savings are less than expected, the contract can be extended to allow the ESCO to recover its agreed payment. A variation is the “first-out” model, in which the ESCO takes all the energy savings benefits until it has received its agreed payment.

**5. Equipment Supplier Credit:** The equipment supplier designs and commissions the project, verifying that the performance/energy savings matches expectations. Payment can either be made on a lump-sum basis after commissioning or over time (typically from the estimated energy savings). Ownership of the equipment is transferred to the customer immediately.

**6. Equipment Leasing:** Similar to supplier credit, the supplier receives fixed payments from the estimated energy savings. However, in this case the supplier owns the equipment until all the lease payments, and any transfer payments, are completed.

**7. Technical Consultant (with Performance-Based Payments):** The ESCO conducts an audit and assists with project implementation. The ESCO and customer agree on a performance-based fee, which can include penalties for lower energy savings and bonuses for higher savings.

**8. Technical Consultant (with Fixed Payments):** The ESCO conducts an audit, designs the project, and either assists the customer with implementing the project or simply advises the customer for a fixed, lump-sum fee.

Source: World Bank 2010.

Attempts are made to make the ESPC model simpler, since many developing countries cannot handle the complex and lengthy contracts and sophisticated M&V methodologies involved in an ESPC approach. In some cases, new approaches have emerged and evolved, and it is fully expected that this evolution will continue in the future. There is however a complete consensus on the fact that ESPC approach is highly relevant for implementing public sector EE projects. The exact package of services covered by an ESCO would depend on the public agency’s needs and the local market’s capabilities, but some of the

basic ESPC elements should be maintained for the public agency to reap the full benefits; that is, (a) ESPCs should tie at least a portion of the ESP remuneration to project performance, and (b) ESPCs must involve project implementation and not just upstream aspects, for example, only energy audits or equipment sales, or only downstream services, such as maintenance.

## 2.2 Model 1: Municipality Borrowing from External Sources for Implementing EE Projects

As depicted in figure 1.2 in section 1.6, this section highlights the features of Model 1 and Model 2 of implementing street lighting projects.

Under Model 1 of implementation, the entire financial risk of the EE in street lighting project is undertaken by the municipality in question. Municipality assumes the responsibility of arranging for finance, usually from a financial institution. On arranging the finance, the municipality can either carry out the implementation by itself, where the **municipality's** own staff is appointed for project implementation. This is usually rare, as more often than not municipalities have limited human resources and also knowledge on EE technologies and measures for upgrading its street lighting systems and technologies with more energy-efficient ones. The other option for the municipality is to hand over the project to experts, which is usually an ESCO or an energy audit and engineering firm to implement the project on a turnkey basis. The ESCO or the energy audit consultant conducts the Investment Grade Audit (IGA) and is in charge of overseeing the implementation of the energy savings/efficiency measures (Alliance to Save Energy 2008). The ESCO or energy audit firm provides consultancy services for a fixed fee. The municipality and ESCO can agree on payment of fixed fees in monthly installments or in lump sum after completion of each task.

One of the benefits of this model is that the cost of capital is generally cheaper for the municipality than the ESCO, thus reducing the overall project costs. In the fixed fee contract with the ESCO, the ESCO bears less risk compared to a savings-based fee payment because their fee does not depend directly on the amount of the achieved savings. Nevertheless, in the fixed fee turnkey project, the municipality bears a number of risks associated with the procurement, installation, commissioning and performance of the equipment, and often this is one of the decision making factors for the municipalities that do not want to carry these risks (Singh, Limaye, and others 2010).

The ESCO conducts the audit and designs the project, as well as arranges for equipment procurement and supervises installation. The payment could be either in installments based on deliverables or a lump sum upon the completion of the project. The fixed fee installments can be paid to the ESCO after each task such as: study phase, contracting phase, implementation phase and post project phase. The fees might differ depending on the complexity of the phase. If it is a lump sum payment, it can be paid at the end of the project.

The main advantage of the fixed fee turnkey contract is that the municipality "owns" the project and accrues all the benefits and the ESCO guarantees a certain amount of savings. The disadvantage of the fixed fee turnkey project is that the ESCO may not agree to guarantee any savings. In this case, the municipality bears the entire financial risk. ESCO bears technical and implementation risks because it must ensure commissioning of the project on time and in accordance with the specifications. Nevertheless, ESCO receives its fee regardless of the actual savings. The financing institutions in India tend to be more comfortable with lending to a municipality than an ESCO because of various credits guarantee options available to Indian municipalities (Alliance to Save Energy 2008).

**Payment Security Mechanism:** Financing of municipal EE projects from external agencies often requires a repayment mechanism that mitigates the risk of nonpayment. There are several models available that help ensure that the loan and all other payments related to the project are re-paid. Other than having the government be an equity partner, two common methods are well suited to turnkey contracting:

- Establish a separate account into which the municipality deposits savings from the project, or
- Set-up a Trust and Retention Account (TRA) in which the municipality deposits revenue from electricity bills and taxes (and/or water bills if water efficiency is part of the project) into an escrow account in accordance with the payment schedule of the loan. Another safeguard option called a reserve fund, which provides additional security to the bank in case of default or any shortfall in the TRA account. The definition of default has to be agreed by all parties. In addition to the municipality making deposits into the TRA account, it also diverts some funds into the reserve account. An escrow agent then makes payments according to the order of preference outlined in the performance contract, usually as follows:
  - Payment of the interest and principal
  - Transfer to the reserve fund
  - Payment to ESCO/consultant
  - Payment to municipality

#### Key Points in the Shared Saving Models

- The ESCO takes on the risk of third party financing from a lender, putting the loan on ESCO's balance sheet
- The savings are shared between the municipality and ESCO with the pre-defined and agreed contract stipulating that the municipality will receive a certain percentage of savings, but it does not guarantee the magnitude of those savings.

## 2.3 Model 2: Public-Private Partnership (PPP) Models in EE Street Lighting

A Public Private Partnership (PPP) approach can tackle the economic crises and boost economy through **infrastructure investment in existing or new structures**. "PPP are forms of cooperation between public authorities and the private sector that aim to modernize the delivery of infrastructure and strategic public services." **This form of cooperation is a long term contractual relationship between a public entity and a private organization where risks are shared and increased financing for EE is mobilized within the private sector to carry out modernization projects in the public sector, with the public partner paying for the delivered services in the long run.** Energy (Service) Performance Contracting (EPC) can be also considered a form of PPP, but only where both public and private partners are involved. This is relatively common form of PPP with well established procedures in some countries. In less mature markets, government can facilitate the availability of financing for EE in local financing institutions (such as banks) by establishing Dedicated Credit Lines or Risk-Sharing Facilities, which- in the case of public involvement can also be considered kinds of PPP (Taylor 2008).

Similarly, PPP in EE Street Lighting sector provides immense opportunity for public authorities (such as ULBs/Municipal Corporation) to undertake low carbon and energy savings projects. When these funds are arranged, major barrier for the implementation is overcome by providing external funding, and municipality also do not have to undertake the technical risk associated with such kind of projects. The municipality is only required to make payments to the ESCO over a period of the time on realized savings.

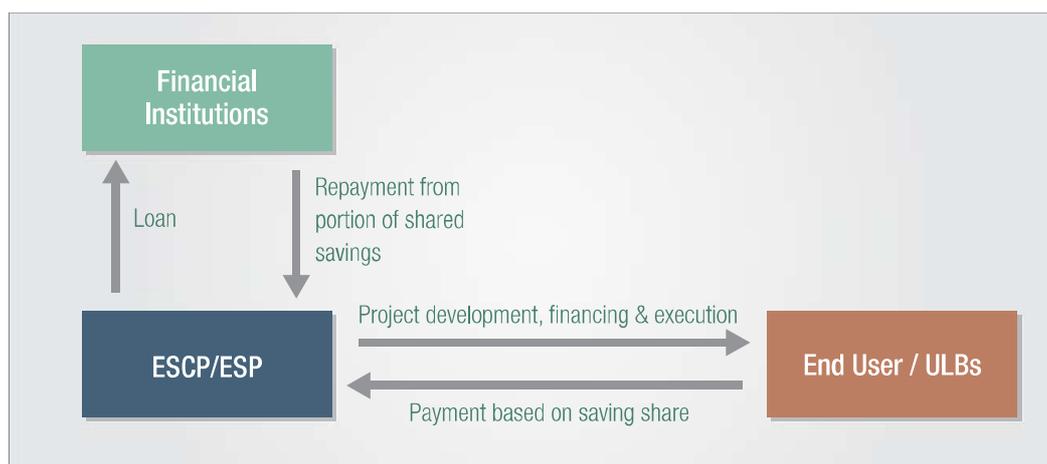
Under the Model type 2 we will discuss 3 types of ESPC models for implementation of EE street lighting projects. Difference between these models is the way project is financed and payments are made for the services, and the way energy and cost savings are allocated between the service provider and host facility.

### 2.3.1 *ESPC Shared Saving Model*

In the shared saving model ESCO generally provides or arranges for the partial or most of the funds needed to execute the project. The ESP and host (for example, ULBs) decide and specify the sharing of

savings amongst them over agreed period of time. ESPC varies between 3 to 10 years with the sharing of payment structured in a manner where ESP will recover its cost of project and receive desired returns on its investment during the period of the project. The host facility (for example, ULBs) does not need to make investment in the project but receives the share of savings during the contract period and all the savings after the contract period (Singh and others 2010). It thus maintains positive cash flow all through the project life cycle. Important thing in such type of project is that, a shared savings agreement must include a prespecified protocol for M&V of the actual savings achieved.

Schematic diagram of the Shared saving model is shown in the Figure 2.1 highlights the financing model under shared savings.<sup>2</sup>



**Figure 2.1: Shared Saving Model**

Source: Singh and others 2010.

### 2.3.2 *ESPC Guaranteed Saving Model*

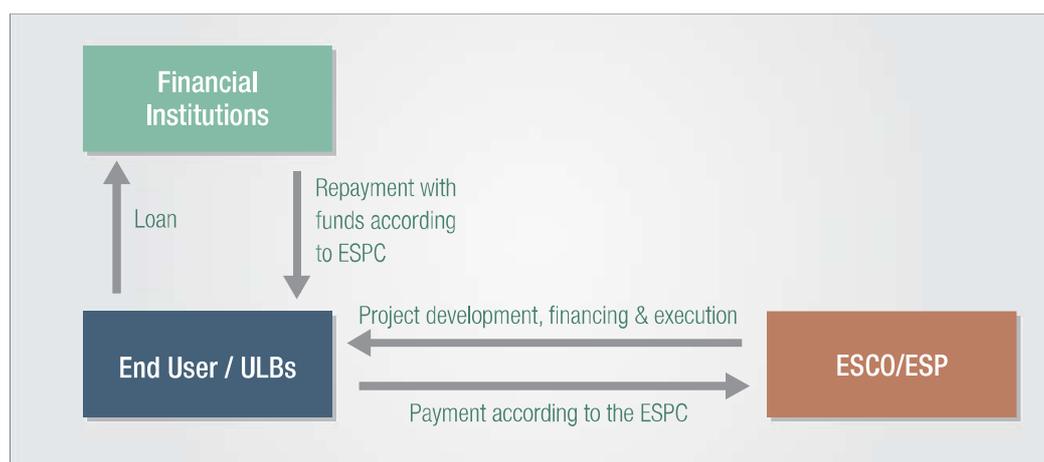
In Guaranteed savings model, the host facility generally takes the required loan or borrows money on its own balance sheet. ESPC generally provides detailed guaranteed energy savings (performance parameters), which also clearly mentions M&V protocols and methodologies. Payment is made once the project performance parameters have been confirmed. The guaranteed savings agreement generally provides the ESP a fixed payment or payment stream upon the satisfaction of the performance guarantee, and it may also give ESP an incentive payment if actual performance exceeds the guaranteed level (Figure 2.2). On the other hand, if the savings fall below the pre-agreed levels, the ESP would be **obligated to cover the host facility's loan repayments until project performance had been restored** (Singh and others 2010).<sup>3</sup>

#### Key Points in the Guaranteed Saving Model:

- The ULBs takes on the third party financing from a lender, putting the loan on its own balance sheet
- The ESCO guarantees that savings will be sufficient to cover the investment cost, and if they are not the ESCO pays the difference between the realized savings and project payments
- Excess savings can be shared between municipality and ESCO.

<sup>2</sup>Case Studies for the shared saving models are given in the Section 8 of the manual.

<sup>3</sup>Case studies for the Guaranteed Saving model is described in the Section 8 of the manual.



**Figure 2.2: Guaranteed Savings Model**

Source: Singh and others 2010.

**Table 2.1: Comparison Table between Shared Savings v/s Guaranteed Savings Model**

ESCO-Shared Savings Model	ESCO- Guaranteed Savings
Performance related to the cost if the energy saved, the ESCO bills upon result	Performance related to the level of energy saved
ESCO carries performance and credit risk as it typically carries out financing.	ESCO carries performance risk and energy-user/customer carries credit risk
Usually off the balance sheet of energy user/customer	If the ULBs/energy user borrows, then debt appears on its balance sheet
Can serve customers that do not have access to financing	Requires credit worthy customer

### **2.3.3 Annuity-Based Deemed Saving Model**

BEE and EESL in the last 5 years have been working with various municipalities in their support to mainstream EE in the governance of ULBs in India. Under its mandate and vision EESL developed innovative programs for the municipalities to undertake EE programs in the street lighting sector. EE street lighting has been identified as the important functionality of any ULBs, which requires a major overhaul in the way they operate and run their services in order to provide better and efficient services to its citizen.

Under its specialized program and detailed energy audits program for ULBs, BEE supported Detailed Project Report (DPR) development for municipalities across the country. This initiative encouraged ULBs to undertake EE programs for street lighting, but because of the various barriers as discussed earlier ESCO-based PPP model for EE street lighting did not receive much success. Integrating this aspect, BEE and EESL designed an indigenous annuity-based deemed savings model to encourage investments in EE street lighting sector and remove the initial barriers to prepare this market for more PPP projects in India.<sup>4</sup>In the annuity-based deemed savings model, the approach is to arrive at deemed savings, with simple, non-complex targets and EE measures, to achieve the objectives of the project. This method involves multiplying the number of installed measures by an estimated (or deemed) savings per measure, which is derived from historical evaluations. Deemed savings approaches may be

<sup>4</sup>Case studies of Annuity-Based Deemed saving model is illustrated in the Section 8 of the manual.

complemented by on-site inspections. Under this model it can be ensured that the best available technology is retrofitted with an overall cost saving to the Municipal Corporations (MCs)/ ULBs. The model divorces the requirement of periodically demonstrating energy and cost savings to get the returns on investments. The cost saving is recovered from the combined expenditure of MC/ ULB on electricity bill and O&M charges.

### **Steps in Implementation of EESL Deemed Savings Approach**

The key stages for implementing the EESL approach to EE street lighting projects are highlighted in the Table 2.2 below. The formats of the key documents involved in the implementation of this approach are included as an appendix to this manual.

**Table 2.2: Stages of EESL deemed saving methodology to implement EE street lighting project**

Stages	Description
<b>MoU</b>	MoU to be signed between municipalities and EESL
<b>DPR/ Revalidation of DPR</b>	Detailed walk through energy audit for data validation of existing DPR and Joint Verification
<b>Technology Demonstration</b>	To assess actual energy savings and determination of annuity payments and finalizing technical specifications
<b>Agreement</b>	Agreement to be signed between municipalities and EESL for implementation.
<b>Payment Mechanism</b>	The Payment security mechanism to be finalized
<b>Implementation</b>	EESL will implement the project based on own resources
<b>M&amp;V</b>	Deemed saving approach used

Source: EESL 2014.

#### **Step 1: MoU between Municipality and EESL**

EESL enters into MOU with the municipality to provide a framework for implementation of EE measures in street light in the jurisdiction of MC. The implementation is undertaken by EESL by investing the entire upfront capital cost of EE interventions, including preparation of Detailed Project Report. The investment of EESL is recovered by payment of annual service charge by MC for the duration of the agreement. The actual annual payment of service charges and the duration of the contract are determined after the completion of the Detailed Project Report by EESL. In some states, particularly where the state government is subsidizing power bills of municipalities, a tripartite MOU is being proposed. A template of tripartite MoU is included in the appendix F to this manual.

#### **Step 2: DPR Validation and Joint Verification**

In the second step, EESL re-validates (included LEDs) the DPRs of municipalities where they are already available or prepare a DPR in case not already prepared. This includes physical verification of the number and type of existing fixtures on sample basis and including LED retrofits of equivalent lumen output. During the process, a joint team of EESL and MC undertakes verification of the number of street light and their rated wattage.

#### **Step 3: Technology Demonstration**

Based on a designated demonstration area decided by the municipality, EESL retrofits EE technology. In the case of streetlights, LED streetlights would be the replacement for existing HPSV/tube lights. The actual consumption data are collected and analyzed with the baseline. The difference is the savings agreed for the entire municipality. The services charge is determined based on the demonstration savings, capital cost to be incurred by EESL, warranties that are provided during the project period, O&M cost and a reasonable return on EESL investment.

The methodology for demonstration of the technology includes replacement of streetlights on the road with LEDs; this is done on the designated area decided by the municipality. Then the following is undertaken:

- Determination of electrical parameters, such as voltage, power factor, and harmonics, of the existing fixture in the designated area.
- Determination of lux output at road level as per specified methodology of National Lighting Code (NLC).
- Determination of lumen output of the existing fixture based on manufacturers data.
- Replacement of LED fixture matching the lumen output of the existing and/or the lux level at the road.
- The data of existing and new LED lights of the designated area are collected. The data is such that it provides the consumption of electricity by existing fixture and that by LED fixtures.

Energy saving is recorded as the difference between the electricity consumption by existing and LED fixtures in the designated area.

#### **Step 4: Determination of Annuity**

The annuity to be paid to EESL depends upon the following parameters:

- Capital cost of interventions.
- Cost of capital of EESL (equity and debt to be invested at a ratio of 30:70).
- Energy savings validated as per the technology demonstration.
- Total savings to the municipality in terms of savings in electricity bill and O&M cost. For recovering energy cost, the current tariffs will be taken. The O&M charges incurred by municipality in the immediately preceding financial year will be taken.
- Equity IRR of EESL (post-tax) of 16%.
- Project management charges will be limited to 2-4% of the capital cost of the project. A reasonable escalation to cover inflation will be added, but will be limited to 5% of the annual payments.

The annuity is calculated based on the aforementioned in a manner that there is a net saving to the municipality because of the reduction of electricity cost and O&M charges. The increase in monetary savings resulting from the upward revision of electricity tariff will not be accounted for in the annuity model. This would be additional benefit to municipalities in future.

#### **Step 5: Technical Specifications**

This step is more of confirming that the LEDs used for replacement in streetlights confirm to BIS standards. The minimum technical specifications would be as follows:

- Powered by the latest bright LEDs with high efficiency and meeting LM-80 standard
- Average rated life span of 50000 hrs.
- LED efficiency shall be greater than 125 Lumens/watt
- Luminaries efficiency of at least 80 Lumens/watt
- Input voltage range 90-300 V
- Power factor > 0.9
- THD < 15%
- Ingress protection as per IP 68
- Operating temperature -5°C to 50°C
- Storage temperature -5° to 70°C
- Humidity 10–100%
- LEDs shall be operated at a forward current less than 90% of its rated current
- The LEDs used in the luminaire shall have minimum angle of 120 degree
- Color rendering index (CRI) of the LEDs shall be greater than 70
- Conform to Photo Biological Safety for the LEDs as per IEC 62471
- Free replacement warranties of 5 years for technical defects

#### **Step 6: Implementation Agreement**

After the demonstration of technology and determination of energy savings and annuity payouts, EESL enters into an implementation agreement that inter-alia covers the following (a template of the implementation agreement is included in the appendix E:

- For the entire Contract Period the LED streetlights supplied shall perform to the agreed standards as per LM-80 and L-70 standards as per BIS.
- Warranty to the products supplied under this agreement will be throughout the Contract Period (of BOT) covering any manufacturing defects.
- If the luminaire fails to the agreed specification, EESL shall rectify or replace it in terms of warranty at its own cost throughout the Agreement Period—or else its payments will be reduced proportionately.
- EESL shall handover to municipality up to 1% of the total quantity of lights in each sector and so as to use these lights as possible replacements for any defects that may arise.
- EESL will ensure uptime of lights installed to be above 90%. Failure to do so will lead to appropriate reduction in annuity.
- EESL will install centralized monitoring and control to optimize operational efficiency.
- EESL shall have no responsibility for demonstrating power savings in the form of periodic power bills.
- The municipality will pay the annual consideration in respect of the above supplies in every month as per the agreed schedule.

### Step 7: Defining a Payment Security Mechanism

In order to ensure that a robust payment security mechanism is in place, EESL has been working on two models:

- Bank Guarantee from MC: EESL requires a Bank Guarantee covering the capital cost of the project to secure its investment.
- State Government Guarantee: In case MC is unable to provide the Bank Guarantee, a tripartite implementation Agreement/and or State Government Guarantee is required to secure investment.

In addition to the above, the implementation agreement has provisions for mitigating defaults by having ESCROW arrangements.

### Step 8: Selection of Implementation Partner

After the above steps are completed, EESL selects an implementing partner through an open competitive bidding process.

### Comparison between EESL Methodology and ESCO-Based Shared Saving Model

Below is the comparative table (Table 2.3) for the EESL-based methodology and ESCO shared savings:

**Table 2.3: ESCO Shared Savings Model v/s EESL Deemed Savings Model**

Issue	ESCO-Shared Savings Model	EESL Methodology-Deemed Savings
<b>DPR preparation and validation</b>	Very detailed as the entire baseline, including energy consumption of lights and other anomalies need to be clearly ascertained. Normally would take 3-6 months to complete the process.	Only technology demonstration and validation of energy savings in a designated area. The resources and the time for the validation are much less in this case—usually about 1 month.
<b>Technology for retrofit</b>	Open to all technologies, such as T-5, induction lighting, and energy savers, in addition to LEDs.	Only LEDs are being promoted for their higher efficiencies, long life and low maintenance
<b>O&amp;M</b>	O&M expenses are usually in addition to the energy savings and are to be paid by the MC to the successful bidder.	O&M is an integral part of the contract. Thus, MC not only gets the benefit of energy savings, but also of O&M cost savings.

<b>Energy Savings guarantee and revenue sharing with ULBs</b>	A minimum energy savings is mandatory in addition to savings share to MC. This need not be result in suboptimal technology from the ULB, since minimum output specifications relating to lux levels are clearly defined in the contract.	No minimum savings guarantee because of baseline and data availability challenges. The annual pay-out is such that there is an overall savings to MC in energy bills and O&M cost.
<b>Revenue Risk</b>	High as the payments are linked to minimum energy savings. In the absence of accurate data and baseline, difficult to achieve.	Low as the payments are not linked to and cost savings. Savings are validated ex ante based on LED technology and built into the annuity that MC pays.
<b>Service Level Agreement (SLA) for performance</b>	An ESCO contract, if designed properly, lays down in great detail the various SLA and output performance parameters, along with the methodology to measures these parameters.	Very detailed SLA for technical performance including warranties for replacement, uptime of lights (>95%).
<b>Centralized Monitoring Control (CMC) for better operational performance</b>	Contracts can include CMC parameters in their projects.	CMC is an integral part of the project. Higher operational efficiencies possible because of centralized switching on and off as well as dimming.
<b>Payment Security</b>	Bank Guarantee and ESCROW	Bank Guarantee / ESCROW /State Government Guarantees

Source: EESL 2014.

## 2.4 Other Instruments for Financing Energy Efficiency in India

Having discussed the ESPC approach to financing EE Street lighting projects, this section provides a brief overview of some of other financial instruments/mechanisms that are prevalent in India for EE financing. These instruments were introduced with a view to address the barriers to EE financing and upscale investment in EE. While these mechanisms are not targeted only for municipal EE projects, these do provide option of financing to ESCOs and have played a role in promoting ESCO development in the country. For example, The Tamil Nadu Urban Development Fund (TNUDF) sponsored an important municipal project. The TNUDF was established as an autonomous financial intermediary in 1996 to improve the operational efficiency of Indian municipalities and help them access private capital. ESPC framework and approach was adopted by TNUDF and in 2007 it initiated a project to implement an ESPC in which projects in seven municipalities were bundled.

Many of the instruments have been introduced for implementing policies such as the NMEEE, the EC Act and some regulatory directives at local level. Some of these were introduced in the past and are now discontinued, and some are currently active, while some others are still in design phase.

The existing instruments and mechanisms for EE can largely be classified into 5 types (USAID India 2013):

- Debt-based financing mechanisms for EE
- Fiscal instruments facilitating EE implementation
- Equity-based financing
- Grants to facilitate EE implementation
- Government EE Funds and Schemes

There are policy and regulatory incentives being provided at the state level in the country, which have focused on municipal projects and some specifically with the view of promoting EE in street lighting. A brief overview of these is presented in Table 2.4.

**Table 2.4: State Level Initiatives for Incentivizing EE in Municipal Projects**

S. No	State/Organization	Policy Initiative	Description
1	<b>Maharashtra/</b> Maharashtra Energy Development Agency (MEDA)	Save Energy program-Financial assistance for carrying out detailed energy audits	In order to tap the potential for energy conservation, Maharashtra Energy Development Agency (MEDA) holds that energy audit is the first step towards identification of potential areas for energy conservation. The main objective of this program is to provide financial assistance to eligible organizations for carrying out detailed energy audit at their facilities through empanelled consultants of MEDA. MEDA is empanelling quality energy auditors for this purpose.
2	<b>Maharashtra/</b> Maharashtra Energy Development Agency (MEDA)	Street Lighting and water pumping Scheme for Municipal Corporation/ Municipal Council / MJP	This scheme is to promote the energy conservation measures in the street lighting systems and water pumping systems. Around four percent of the energy consumption in the state is through the state water supply and two percent of energy consumption is through street lighting systems. This scheme says that around 30 percent of energy conservation is possible in both the categories. Hence it is needed to promote energy conservation program in these areas. Through this scheme, municipal corporation/municipal council can avail for a subsidy of Rs 25 lakh for implementation of energy conservation measures. And Maharashtra Jeevan Pradikaran (MJP) can avail for a subsidy of Rs 5 Lakh for implementation of energy conservation measures.
3	<b>Haryana/</b> Department of Renewable Energy, Government of Haryana	Scheme on Interest free loan for Energy Conservation Measures	This program is mainly for providing financial assistance to the industries, institutions, municipal and commercial buildings for implementation of the energy audit report for achieving higher EE. The assistance will be in the form of interest free loans against a bank guarantee of 1.25 times of the assistance for three and half years. The financial assistance would be limited to 75 percent of the cost or Rs. 20 lakh, whichever is lower, and it would be paid back by beneficiaries to HAREDA in five installments. The time limit for the implementation of project is nine months from the date of sanction of financial assistance.

4	<b>Rajasthan/</b> Rajasthan Renewable Energy Corporation Limited (RRECL)	Public street lighting systems	As per the notification by the Rajasthan government to optimize the energy use by the EE street lighting system at the ULBs. The Energy department of Rajasthan has issued a notification No. F.20(6)Energy/98/pt dated July 1, 2010, which issues the directions to be followed by all Municipal Corporations, Municipal Councils and Municipal Boards for the efficient use of energy and its conservation in the Public Street Lighting.
5	<b>West Bengal/</b> West Bengal Electricity Regulatory Commission	Reduce tariff for the EE LED Street Lighting system	Municipalities in the state of West Bengal can avail the incentive of reduced tariff (Rs.5.71 per unit to Rs. 3.96 per unit) for LED street lighting system. To avail the reduced tariff with LED street lighting system, the supply should be metered and all the streetlights under the same meter shall be illuminated with LED. For the mixed type of street light system non-incentivized rate is applicable.
6	<b>Tamil Nadu/</b> Tamil Nadu State Government	Tamil Nadu Solar Policy 2012-Off Grid Solar Photo Voltaic Programme	<p>The program is a major initiative under JNNSM and was launched in the year 2009 by MNRE. This program supports various off-grid solar photovoltaic applications such as solar lanterns, solar home</p> <p>Lights, streetlights, water pumping systems and stand-alone power projects.</p> <p>Salient Features:</p> <p>MNRE will 30 % subsidy or/and loan at 5% on 50% benchmark cost.</p>
7	<b>The Ministry of New and Renewable Energy (MNRE)/</b> Government of India	Incentive/Subsidies by the MNRE for Renewable Energy Products	MNRE did introduce incentives and subsidies for the various EE and Renewable Energy product. In case of the Solar Street Lighting system MNRE provides subsidies/incentives 30 % of the product cost. For the special category state this incentive is 60 % of the product cost.

## 3 INVESTMENT GRADE AUDIT (IGA) FOR EE IN STREET LIGHTING

The energy audit is an important step to assess how much energy a street lighting infrastructure consumes, determine whether or not cost-effective EE options exist, and identify which systems merit more detailed study. It is a simple but important hurdle in getting the project to the next step. Energy audits can be conducted in varying degrees or levels of technical detail, accuracy, and complexity based on the purpose. Energy audits have generally been found to fall into three basic categories—walkthrough, preliminary, and investment grade.

For the purpose of ESPC procurement, all three are relevant. In many countries, a *walk-through survey* is typically performed by a third party engaged by the public agency, and the results included in the Request for Proposal (RFP). A third party is often required because conflicts of interest can arise if the firm that conducts the energy audit is also allowed to bid on the resulting project. However, this does not stop a municipality to conduct a walk through survey itself to undertake a preliminary assessment of the EE potential. During the bidding process, each bidder is invited to visit the proposed street lighting projects facility and conduct its own *preliminary energy audit*, so as to be able to prepare proper technical and financial proposals. Once the contract is awarded, the selected ESP conducts an *investment grade audit, or IGA*, to finalize the precise details of the ESPC, document the baseline, and develop the detailed project design.

Ideally all three audits should be undertaken. The self-assessment done by the ULB/Client will help in taking a stock of the current status. The preliminary walk-through audit is a pretty straightforward activity by the client or prospective implementer to help them in bidding process. IGA is necessary to agree on the savings for ESPC.

### 3.1 Self-Assessment and Walk-through Energy Audit (WTEA)

Before proceeding on implementing an EE project for street lighting, a basic step on part of the municipality is to undertake some sort of self-assessment to choose the best option for undertaking the EE program. Having established that EE in street lighting is an area it wants to implement, it then needs to select the type of contract and financing option before moving forward with the EE project (that is, Model 1 or Model 2.1/2.2/2.3 from the previous section of the manual). Having established that the EE is a priority area for intervention a municipality will have then dwell into collecting energy usage data by carrying out a preliminary (walk through) audit.

A preliminary (walk-through) audit, entails taking stock of basic energy usage and other relevant data, and internally assesses the low cost and no cost options that can be implemented. This initial audit study is important for the municipality to determine how much energy a particular street lighting system consumes. It also helps to determine whether or not cost effective EE options exists, and identify which system merit more detailed study.

Undertaking a walk through audit is also integral to an ESPC approach, because the public agency must confirm that cost effective energy savings opportunities exists, it must also assemble credible technical data and analysis to reduce the cost to the bidders of preparing their proposals, and must provide notional definitions for projects scope that could be made part of the RFP for hiring an ESCO as a later stage.

## 3.2 Investment Grade Audit (IGA)

IGA being the most detailed of all energy audit provides maximum details and analysis possible on energy savings and measures. As the name implies, an investment grade energy audit is the process of conducting an energy audit to identify efficiency opportunities, and translating the technical findings into financial terms to present it as a bankable project capable of securing a loan. The IGA report contains comprehensive information related to energy use by the municipality and provides clarity on the baseline and verifiability of savings once the project is implemented. The investment grade audit documents current technical conditions, recommends energy saving projects, and presents the technical descriptions of the potential EE measures along with an assessment of the expected energy savings.

Key steps in undertaking an Investment Grade Energy Audit (IGA) include the following:

### 1. Discussion with ULBs street lighting infrastructure O&M team

ESCO in its first step should conduct kickoff meeting to discuss about the details of the project and learn from the experience of the current staff who are handling the infrastructure in the city. During the interaction both ESCO and ULBs staff should clear any confusion about project expectations and boundaries. Also, freeze the project schedule and set up communication protocol for the smooth execution of the projects. The key personnel of the municipality such as the municipal commissioner, municipal engineers, and pump operators can participate in this discussion.

### 2. Site Visits and Preliminary Data Collections

ESCO should arrange for the infrastructure site visit for initial preliminary audit. Also, it will give them with an idea of the state of the current infrastructure. This will help ESCO to formulate its strategy and identify the data collection points for detail audit report for the project.

The ESCO will try to map out the existing facility for street lighting in the proposed project area. ULBs official can assist the ESCO by providing the correct and updated system map and inventory details. **The ESCO then designs “data format sheets” for recording monthly energy consumption and** operating data for the last three years. Historical data is generally accepted as the previous three years of energy bills for a given facility. Analysis of the data helps the ESCO to identify systems for detailed measurement and monitoring.

### 3. Steps for conducting detail audit of the street lighting infrastructure

A detailed audit includes data collection, measurements of the systems, analysis of the historical and measured data, and detailed energy savings calculations for suggested projects. The ESCO not only analyses the performance of individual equipment, but evaluates the complete system. The steps under conducting the audit would include the following.

- Formation of steering committee by the municipality to guide the entire process
- List of proposed energy conservation measures
- Baseline calculation
- M&V

### 4. Audit Report

The detailed audit report is the most important and expected to be comprehensive project document for EE street lighting project (Table 3.1). It is the key document that will be required by financial institution to lend to the project.

**Table 3.1: Key Elements of Street Lighting Audit Report**

Contents	Description
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<b>Executive summary</b>	Provides a brief description of the systems and facilities covered; overview of the existing conditions; measures evaluated; analysis methodology; results and a summary table presenting the cost and savings estimates for each recommended measure. It also includes a summary of the recommended measures and costs, as well as the financial indicators of the projects, and indicators to measure other impacts of the project (such as quality of service, impact on municipality's budget, and greenhouse gas impact).
<b>Background</b>	Extensive background about the municipality and project should be provided.
<b>Facility description</b>	Details of existing facilities targeted, such as street lighting, poles, and electrical distribution systems. Compliance with relevant norms. (See also Appendix C1 & C2 and section 6.2 of the manual for example of data to be presented.)
<b>Energy scenario</b>	Energy consumption details of all the facilities.
<b>Inventories</b>	Inventories of all relevant systems related to public lighting
<b>Methodology, baseline parameters, and adjustments</b>	Methodology followed in establishing the baseline parameters and the criteria to trigger adjustments, along with the methodology to be followed for the adjustments. Provide all baseline parameters and calculation procedure in an annex.
<b>Data collection</b>	Prepare data collection sheets (and guidance for the data collection system), listing the various types of data collected and their sources, including on operational details of the lighting system. Include data in an annex.
<b>System mapping</b>	Prepare GIS based smart street lighting system map for the project area. This will also act as a inventory tool with the all infrastructure being mapped in the tool for the street lighting in the city.
<b>List of potential measures/projects</b>	A list of all identified measures with estimates of the investment cost, energy savings, and payback on investment.
<b>Review of current operation and maintenance practices</b>	Provide detailed description of current operation and maintenance (O&M) practices within the municipality facility, including hours of operation and use of meters and control systems, as well as dimming. This will include discussions with operators, engineers, and other staff; observing the day-to-day O&M; and reviewing the log sheet during the field study. Areas for improvement should be identified and suggestions made for implementation strategy and methodology. Also, provide equipment replacement schedule and associated costs.
<b>Details of the approved projects</b>	<p>Each of the approved projects should be discussed in the report along with the following information:</p> <ul style="list-style-type: none"> <li>• <b>EXISTING SITUATION:</b> Describe the existing situation, including operational practices associated with the planned efficiency improvements, and including a graphic presentation.</li> <li>• <b>PROPOSAL:</b> Provide background of the opportunity for improvements, and describe proposed measures. See Appendix C1 &amp; C2 for example of description of new lighting system. Discuss propose retrofits and modifications necessary for achieving savings and associated cost-benefit analysis.</li> <li>• <b>BASELINE PARAMETERS:</b> Establish the baseline parameters for the project and any adjustment that might be required over the course of the project.</li> <li>• <b>M&amp;V PLAN:</b> Develop an M&amp;V plan for the project.</li> <li>• <b>CALCULATIONS:</b> Energy savings and other calculations (include in an annex). <ul style="list-style-type: none"> <li>-Provide a detailed energy analysis for each energy-saving measure proposed, documenting estimated annual energy savings. Document assumptions on current and proposed equipment operating condition and energy savings calculations.</li> <li>-Greenhouse gas calculations.</li> <li>-Economic calculations on a life-cycle basis, including both energy and operation and maintenance costs and savings.</li> <li>-Other measurable impacts (related to quality of service, budget situation of the municipality, and so forth).</li> </ul> </li> <li>• <b>MONITORING AND VERIFICATION (M&amp;V):</b> Develop an M&amp;V plan for monitoring, verifying, and guaranteeing energy savings from the implementation of the energy-saving measure, including identification of monitoring equipment, availability, confidence interval, and data collection procedure.</li> <li>• <b>IMPLEMENTATION SCHEDULE:</b> Provide a proposed implementation schedule, including, for example, design completion, equipment/material acquisition, installation, start-up/testing, installation, and training.</li> </ul>

	<p>• <b>RISKS AND THEIR MITIGATION:</b> Assessment of potential technical and financial risk and a risk mitigation plan (presented in a Risk Matrix),* such as:</p> <ul style="list-style-type: none"> <li>-Design and construction risks (for example, baseline establishment; technical efficacy; completion risk; delay in construction; compliance with standards and government approvals).</li> <li>-Performance risk (for example, equipment performance, accuracy of savings estimates, M&amp;V risk, operational changes, and capacity of personnel).</li> <li>-Financial, economic, and regulatory risk (cost overrun—initial and operating; regulatory—changes in laws relating to tax concessions and so forth; and financing).</li> <li>-Market risk (energy price risk due, for example, to changes in tariffs).</li> </ul>
<b>Proposed training</b>	Proposal for short- and long-term training for facility personnel (including implementation of energy efficiency measures and M&V).
* Matrix would provide classification or type of risk, reason for the risk, and risk mitigation measure adopted.	

### 3.3 Technical Scope of Work for an IGA

The technical scope of work for IGA for street lighting will include, but not be restricted to the activities listed in Table 3.2.

**Table 3.2: Technical Scope of Work for IGA for Street Lighting Projects**

Activity	Description
<b>Street Lighting System Mapping</b>	<ul style="list-style-type: none"> <li>• Layout transformers indicating their sizes, capacities, loads, and locations.</li> <li>• Sketch of the distribution system indicating type of lamps, approximate distance between the pole, type of poles, conductor material and size</li> <li>• Identify the point where electrical parameters need to be measured</li> <li>• Prepare the data sheet for inventory details about the operational details of the lighting systems</li> </ul>
<b>Data Collection</b>	<ul style="list-style-type: none"> <li>• Number and locations of substations in the municipality</li> <li>• Design details of all transformer in the substation</li> <li>• Operational hours of the individual transformers on daily basis for past 12 months</li> <li>• Details of the power supplied for street lighting system from each of the stations on daily basis for past 12 months</li> <li>• Electricity bill for individual street lighting circuit for past 12 months</li> <li>• Number and types of lights replaced in past 3 years</li> <li>• Number and locations of street lighting transformers in the municipality</li> <li>• Numbers of feeders and conductor sizes in each of transformer</li> <li>• Number and type of lights in each of the feeder</li> </ul>
<b>Preparatory work for measurement</b>	<ul style="list-style-type: none"> <li>• Identify the location for measurement of the electrical parameters in the street lighting circuit</li> <li>• Voltage profile of the lighting system at the substation level and at the lighting transformer side simultaneously for 24 hours</li> <li>• The municipality must provide the samples of all bulbs or lamps used for street lighting</li> <li>• Measurement of existing lux level, height of pole and Color Rendering Index (CRI)</li> <li>• Other recognized parameters that are required to complete the system profiling</li> </ul>

Baseline development activity is important component of any IGA. Baseline development is one of the very important processes and plays very important role in the project development for EE street lighting.

The following section focuses on essentials of an effective baseline development for EE street lighting projects.

### 3.4 Baseline Development

Baseline energy consumption is one of the most critical aspects of any EE program and its determination is a central task in any energy savings calculation and evaluation process.

Baseline is the basic information gathered before a program/project begins and is used to provide comparison for assessing the effect of the program/project. The purpose is to monitor and assess activities progression and effectiveness. Baseline establishes a level of energy consumption before an energy conservation measure is implemented. Each energy consuming equipment, process or activity has a baseline energy use level and these combined together for a program/project form the overall baseline.

Simplified energy savings calculation is represented below:

$$\text{Energy savings} = \text{baseline energy consumption} - \text{actual energy consumption}$$

Hence, baseline can be defined as the energy consumption that would have occurred if no energy conservation measures had been taken up to influence the energy consumption

Concept of baseline energy consumption and its corresponding formulation are carried out on a conceptual level explaining the different strategies and approaches for a specific program. With respect to energy-efficient street lighting program we define **baseline as “The electricity consumption of the streetlights in a designated area prior to implementation of energy conservation measures.”** Keeping this definition in mind methodologies to develop baseline are discussed in the next section.

#### Box 4: Interpretation of Baseline from Different Literature

*“Would have occurred had the program not been implemented.” (Vreuls 2005)*

*“What would market actors who participated in (or who were exposed to) the programmes have done in the absence of the programme?” (Dietsch 2007)*

### 3.5 Methodologies for Developing Baseline

As per the current market practices, there are two methods for developing the baseline. Both the options are simple to adopt at the same time and accurately calculate the baseline energy consumption.

#### Option 1: Baseline Development Based on Lamps

A detailed inventory of the existing lights, pole dimensions, operating hours and road dimensions should be collected. A suitable energy-efficient replacement for each lighting fixture with matching lumens or acceptable lux levels for the road conditions should be suggested. This exercise should be repeated for each light in the project.

All the important pre and post installation parameters should be recorded. For example (Table 3.3)

**Table 3.3: Draft Table for Pre and Post Installation Technology Description**

Parameters	Pre Installation	Post Installation
<b>Lighting Technology</b>	LPSV	LED
<b>Wattage (W)</b>	150	60
<b>Lumens (lm)</b>	7500	7000
<b>Street Name</b>	ABC	ABC
<b>Street Dimensions</b>	XYZ	XYZ
<b>Operating Hours</b>	12	12

Source: Author.

These parameters are collected for each lighting fixture or light, and information for the same street is kept together; it can be based on similar lighting technology or for lights on the same circuit.

The annual baseline energy consumption is calculated based on the number of lamps, lamp wattages and estimated annual operating hours. The post installation energy savings for each retrofit lamp replacement can be determined. While establishing the baseline, proper care should be taken to consider number and wattage of glowing and nonglowing lamps.

**Table 3.4: Draft template of table for Option 1: Baseline development on basis of lamps/switch points**

S. No	Project Status	Road Name	Lamp Type	Operating Hours (hrs)	Annual Energy Consumption (kWh)	Annual Energy Savings (kWh)
1	Pre Installation (Baseline)	ABC Street	150 W (LPSV)	12		Baseline- Post Installation kWh
	Post Installation	ABC Street	60 W (LED)	12		
2	Pre Project	ABC Colony	40 W (TL)			
	Post Project	ABC Colony	16 W (LED)			

Source: Author.

Baseline adjustment should to be done on the basis on the number of glowing lamps and nonglowing lamps and their wattages. Illumination level is usually measured as per the 9-point method.

### Option 2: Baseline Based on Actual Metering

The second option to determine the baseline energy consumption is through metering the actual energy consumption for a predefined period. For energy saving calculation the post installation metering has to be carried out for the same period as the baseline under similar conditions and on the same switch points.

For this option number of switching points should be identified and different electrical parameters should be recorded for a period of time. Proper accounting of the number and wattages of glowing and

nonglowing lamps should be taken during this period to avoid incorrect baseline calculation. Average illumination should be calculated following the 9 point method (Table 3.5).

**Table 3.5: Draft template of table for Option 2: Baseline based on actual metering**

Sr. No.	Location / Street	Street Type	Switch Point Phase	No. of Poles	Lamps per Pole	Type of Lamp and Wattages			Period of Recording		Baseline Energy Consumption (kWh)
						HPSV (70/150/250/400)	MV (70/150/250/400)	FTL	Start Time	End Time	

### 3.6 Key Steps to Consider for Baseline Development

Some of the key steps to be considered for baseline development with respect to street lighting EE program include.

#### 1. Period of Baseline Study:

Baseline study should be conducted before the onset of retrofit activities in order to establish the pre-installation exposure conditions of the outcome level indicators. However, it is not uncommon for baseline studies to be conducted after the retrofit activities have already begun. When this is not possible, baseline studies must take a high priority and data should be collected very close to the beginning of the operation, at the latest. Sometimes the data needed for a baseline, against which to measure the degree and quality of change during an **activity's implementation, will already exist. In such cases the only task is to collate the data and ensure that it can be updated in the longer term.** So it is important to find out what information is already available, though most times it will require supplementation and further disaggregated depending on the nature of the indicators.

The time required to carry out the baseline study depends on the data collection method. Baseline data collection can be done by:

- Reviewing the electricity bills and inventory data
- Actual field visits to measure the quantity
- Actual filed visits to measure the quantity and to meter the energy consumption

Hence, the period of the baseline study is project specific with multiple variables, such as data collection methods, project size, and available data. It can be said that the period of baseline study can vary from 3 days to 4 weeks, depending on the above-mentioned factors. These timelines, however, have been observed to extend for longer periods. Generally, because of the lack of capacity of implementing agencies (both ESCO and ULB), lack of good quality historical data and administrative delays lead to the longer baseline collection period. To avoid this, it is important for ULBs and ESCOs to understand the gaps and problem areas to assess the realistic timeline for completing the baseline study. Longer baseline studies do increase the transaction cost of the project.

#### 2. Devote Time

Time devoted to research and planning at the beginning will help to minimize the risk of improper results and ensuring that the baseline study will be meaningful, relevant, cost effective and not overly academic.

#### 3. Baseline Data/Inventory

Baseline study should mention all the categories and subcategories. An inventory of all equipment make, model, and location should be collected, which can be verified in the future if needed. The source of the data should be noted. The number of nonworking points and lamps should be calculated during the baseline studies, which should be taken into account in the potential energy savings calculations.

#### **4. Identify the Static Factors**

Identify the static factors which will affect energy use in the measurement boundary but are not included in the routine adjustment. Example is a substantial change that might occur in the operating hours, or lux level.

#### **5. Measurement Techniques**

Measurement techniques should be planned in advance and the barriers and challenges that might be faced should be listed. In the event measurement is not possible all assumptions along with the rationale should be presented. For example one can estimate the baseline energy consumption by multiplying number of installations (lights) by their name plate energy data, or using historical data similar to what is followed in the deemed savings calculations.

#### **6. Linkage with Planned Activities**

The baseline study should be closely linked with the critical aspects of the monitoring plan so that the data collected can be replicated if necessary during on-going activity monitoring and any subsequent evaluations. Baseline data should provide the minimum information required to assess the quality of the activity implementation and to measure the development results.

#### **7. Data Management System**

Planning should include adequate provision for data collation and analysis, including appropriate staff, materials such as computer software and recording forms, data storage facilities and a clear picture of who will need to access data and in what form.

The data management system for baseline data storage and mining should be simple in nature and user friendly. The staff responsible for the data storage and mining should be computer literate with a basic knowledge of Microsoft Office and should be familiar working with programs such as Word, Excel, and Access.

Historical data from the ULBs or utilities, such as the electricity bills and inventory details, can be scanned and stored in PDF format. Important inventory and electricity bill data can be fed in a simple Excel spreadsheet.

Soft copies of onsite data collection forms should be maintained and updated with the on field data collected by the surveyors, in addition scanned PDF copies of the onsite data collection form should be created so that data is not lost or misplaced. All files and data should follow a predefined naming convention for ease of access.

#### **8. Reconstructing Baseline Data**

In the event no baseline study was carried out prior to installation and completion of the project and no baseline data is available, reconstructing the baseline data is necessary using secondary data, project records and interviews.

Secondary data comes from old records, interviews, and purchase records. Any data that is not first hand from the field or measured. The interviews suggested are unstructured interviews involving proactive and innovative approach by auditors to collect as much reliable data as they can get for purposes of baseline (refer to Table 3.6).

**Table 3.6: An illustrative secondary data collection and interview template**

S. No.	Road Name	Road Category	Lamp Type	Quantity	Metering Point	Energy Consumption (kWh)	Average Illumination (Lux)	Source of Data	Comments

## 4 SECTION 4: PROCUREMENT AND CONTRACTING

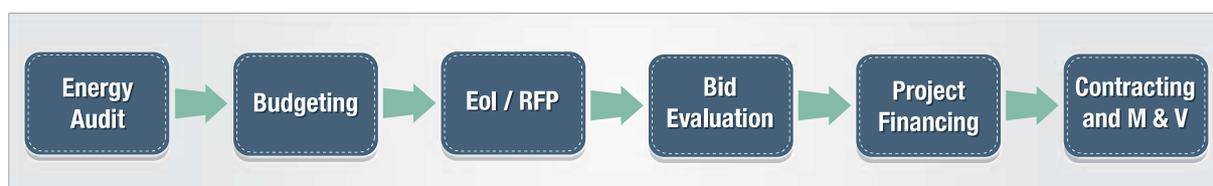
Public procurement in public sector specifically EE street lighting sector faces many in built issues and challenges as we have discussed earlier and creates barriers to EE investment in the Mu DSM sector. **ESPCs are not a “magic bullet” to solve the deep and complex issues related to improving EE in the public sector.** However, many of the core elements of ESPCs are quite attractive as means to deal with prevailing obstacles to achieving EE gains in the public sector (such as in the Municipal EE Street Lighting sector).

We have discussed broadly two types of public procurement: Turnkey Contract to ESCO/ESP at fixed fees basis and Energy Saving Performance Contract. In both the models we have discussed about the role of outside agency (Private Sector) in executing EE street lighting project for the public agencies.

In this way private sector brings its sectors experience and private investment and transfer technical risks from the ULBs, removing equipment procurement processes from rigid government requirements, and offering more flexible financing options than fixed annual budgeting systems may provide. More importantly, project development can be outsourced to an entity that has the skills and incentives to overcome any short-term barriers and help realize the significant EE potential on public premises. All over the globe both developed and emerging economies are looking to implement performance contracting approach to EE street lighting projects.

Public procurement is not a standardized solution. Agencies and public bodies are required to customize the process as per the specifics of the barriers and issues faced by them. Some of the barriers to EE implementation can be addressed by applying performance contracting approach to optimally utilize the private sector efficiency and promote most EE technologies in the public street lighting space. In this approach ULBs can engage commercial service provider to design and implement such projects that includes guarantee of energy savings or other performance parameters. The service provider can offer range of services to concerned ULBs, such as energy audit, project identification and design, equipment procurement, installation and commissioning, M&V, training and O&M (Singh and others 2010).

Key steps for any public procurement of the EE services have been identified after implementation of the various projects across the globe. Lessons from these projects have helped in listing key component of the good procurement contracts (Figure 4.1).



**Figure 4.1: Key Steps in the Standard Procurement Process**

The contract between public agency and service provider must be designed to address the concerns and issues of the all the relevant stakeholders for successful contract. These concerns are usually related to performance guarantees, payment fees structure and model, M&V, and agreement on the baseline for measuring energy savings during the projects. Good procurement contract should provide clear guidelines for every step involved in implementing this contract. Many basic parameters are required to be sorted, at any early stage by the public agencies to avoid any conflict with the service provider later during the implementation. It is important to carefully examine the issues of the exact project cost and detailed performance parameters because in most of the ESPC models, payment fees is linked with the performance parameters laid out in the contract. As, observed in the different pilot projects across the globe, this is an issue because some of the above important details will be confirmed only after the comprehensive IGA and precise agreement is difficult to achieve during the RFP stage of the procurement stage.

This section of the manual defines the key contracts involved in each of the implementation models discussed in part 2 of the manual.

## 4.1 Turnkey Contracts for ESCO or Energy Service Provider (ESP)

Turnkey contracts awarded to the ESCO or ESP for varied services at the fixed or lump sum fees is the traditional mode of procurement process used by the ULBs for public procurement (*applicable to Model 1 explained in Part 2 of the manual*). ULBs either raise resources internally or borrow externally to fund the project. They have various options in taking service of specialized agency for implementation. The designated government agency will competitively procure one or more services (such as IGA, Installation, or O&M) through one or more ESP or ESCO. This type of contract allows parent agency to bundle smaller project assignments and gives room for flexibility. Also, since there is less competition for the sub awards, it is easier for selected ESPs to negotiate energy audits and detailed project proposals directly, without excessive concerns over proprietary information, initial audit costs, and the like. In traditional model, agency retains full benefits of the energy saving from the project and ESP/ESCO is paid on fixed basis. In this model, payment is usually an input-based model with minimum output specifications to the service provider. Payment is also a time-based or delivery-based model rather than a performance-based model.

However, these contracts have flaws in their design. Nontransparent procurement can create negative impact on the project implementation and will not allow new entrant to enter in the procurement process. Also, as has been sometimes observed, this model for procurement gives less leverage to public entities to negotiate on price. Other major cons for turnkey contracts are as follows:

- No accountability for the result as payment fees is depended on the input rather than performance (that is, output)
- Auditors and designer generally lack practical experience and are not well versed with field related constraints
- Discourage innovation
- Public agency (that is, ULBs or municipalities) assumes performance risk of the system and project.

This model is successful where public agencies (such as municipalities or ULBs) have strong capacity and familiarity with the EE measures in street lighting space. Also, it is preferred mode of operations for those entities that are self-sufficient in raising funds internally or externally for such projects.

An outline of the template for a turn-key contract on a fixed fee basis between an ESCO and municipality to undertake an IGA is provided in the Appendix A of this manual.

## 4.2 Request for Expression of Interest (EOI)

For conducting and implementing EE street lighting projects in India, ULBs or public agencies should call for Request for Expression of Interest (EOI) from the interested bidder and service companies. This is the first step for the selection of the interested parties for implementation. The model EOI contains the brief description of scope of work, basic information about the infrastructure and installation (street lighting) that needs to be included in the project, request information about the technical and financial capabilities of the bidding firms and their list of resources employed for the project. In the forthcoming sections of this manual, we have provided a Vendor Qualification Matrix, which ULBs can use to evaluate the bidders qualification.

An outline of the template for EOI for hiring of an implementation agency is provided in Appendix B of the manual.

## 4.3 Request for Proposal (RFP)

ULBs should issue the request for proposal to the viable and qualified bidders, shortlisted through the EOI. The RFP describes the current street lighting installations inventory and details (that is, energy use, inventory, equipment, current O&M practices, and utility bill history) which should help bidders in preparing their bids. It is recommended that pre bid meeting and project location site visit should be **arranged for the bidders to assess the proposed project's scope of work and get** clarifications from the agencies regarding any queries related to project and RFP. For this also, ULBs can use Vendor Qualification Matrix presented in the forthcoming section of the manual for evaluating the bids submitted by the service companies.

Template for RFP for hiring an implementation agency for undertaking the IGA and implementation of EE street lighting project is presented in Appendix C of this manual. This Appendix also contains Template of RFP for "Supply, Installation, (Retrofit), Testing, Commissioning, Warranty, Maintenance of LED streetlights and Related Works," for the ESPC Model 2.3 mentioned in part 2 of the manual (that is, Annuity-Based Deemed Savings Model).

## 4.4 Contract to Undertake an IGA

ULBs need to enter into a contract with ESCOs or any other implementing agency to undertake an IGA. If an ULB is funding the project by procuring private financing (Model 1), the ULB could contract with an ESCO on a turnkey basis for carrying out an IGA and implementing EE measures. If the ULB is keen on utilizing the ESCO mechanism to finance the EE project, then the municipality should start out by procuring the services of an ESCO to do an IGA, reach an agreement on the end-user payment mechanism, and draft the contract agreements accordingly.

An outline for template of an IGA contract on a fixed fee basis is included in **Appendix A**.

## 4.5 Energy Savings Performance Contract (ESPC)

General engineering contracts and ESPC model differ in various ways because firms which are contracted are compensated based on actual energy savings resulting from the project implementation, instead of a fixed contract price. As already discussed in the previous section that these models (that is, ESPC) overcomes the barriers of requirement of upfront capital to design and implement the project in the municipal area. Rather, it guarantees further savings in energy demand to finance practical, engineered plant improvements. It is an innovative way of bringing about change and reducing risk- overcoming a lack of in-house technical skills, resources and budget.

Few key parameters required to make this model a success. EPSC could be profitable for both parties, but a good preparation and partnership collaboration on the basis of adequate and proven contract models is essential. The success of an EPSC project depends mainly on the tendering procedure. After the decision to implement EPC, the lighting data is listed in the course of project development. With its help the operating (energy and maintenance) costs baseline is determined to serve as the reference value for the operating costs in the contractual period. Furthermore, the standards or system requirements should be defined at this stage. This requires clarification of the interfaces with regard to maintenance, definition of the minimum savings to be achieved and if a share in the savings is desired.

The performance contract document determines the terms of project operation over the entire contract period. It defines in detail the relationships, roles and responsibilities of each party, and clearly explains the mechanism of project performance and any savings guarantee. The performance contract is a long term agreement between the municipality and ESCO. Therefore it has to be flexible enough to accommodate both the current and future needs of the facility for the duration of the contract term. The performance contract should contain the basic legal provisions and protections to which each party

will confirm, as well as specify governing laws and pertinent regulatory requirements (for example, insurance and code compliance), liabilities, conditions of default and remedies, and indemnification provisions. It can be customized to accommodate additional terms and conditions as necessary. An ESP contract will have to be prepared for each type of submodels under Model 2 mentioned in the previous sections of the manual. The main components that need to be included in the contract comprise the following:

### ***Scope of Work***

Typically municipality should assign the scope of work (SOW) to the interested vendor or ESCO in full clarity and transparency. All the details of the project and its components should be clearly defined and accommodate all the concerns of stakeholders of the project. SOW typically includes the description of the services to be delivered with respect to the engineering, design, implementation, O&M and training (capacity building). This section will also include all the details of procurement, installation, financing, commissioning of ECMs, and monitoring of all the savings that are agreed in the contract.

### ***Roles and Responsibilities of the Parties***

Municipalities and ESCOs (service providers) are both important stakeholders in this process in order to optimally achieve the desired **savings from the project. Therefore, municipality's role and responsibility** should be defined in the contract. For successful implementation, the contract should detail upon performance parameters, specific technical standards, risk matrix and field related information, such as drawings, location, map, energy consumption data, operating data, and previous inventory list.

The ESCO is responsible for implementing all items as described in the scope of work, as well as helping to obtain licenses and approvals and coordinating engineering and construction services done as part of the project.

### ***Terms of Agreement***

The contract must specify the term of agreement and the conditions under which it can be terminated. Such conditions can include, for example, failure to perform according to schedule or failure to reach financial closure on the financing for the project.

### ***Payments Terms***

The contract must clearly specify price of the contract, the methods of payment to all parties to the contract, as well as billing procedures.

### ***Ownership of Equipment***

The contract should specifically mentions about the exact ownership of the project during and after the contract. Different models of ESPC have different models of ownership:

- In case of the guaranteed savings type of contract, the equipment typically belongs to the client (municipality) during the project period and after it. No transfer of the ownership is required in this case.
- In case of the shared savings type of contract the equipment is usually owned by ESCO during the project period, with ownership transferred to municipality after contract expiration. The terms of the ownership transfer should be clearly defined in the Performance Contract based on existing legal and accounting practices.

### ***Standard of Service and Comforts***

Municipality needs to define the standards of the service provided by the ESCO during the contract period as per the national and relevant standards. Street lighting equipment and design should adhere

to all the necessary national and relevant standards. Also, ESCO should also take care of Environment, Health and Safety standards during all the phases of contract period.

### ***Risk, Indemnification, Insurance***

The contract contains provisions to protect municipality and its employees from any damages or liability caused by the ESCO's performance during the contract term. Also, the cost of which is generally covered by the ESCO. Risk management includes a hazardous waste disposal plan, if applicable.

In cases where the contract includes savings guarantees, the contract specifies the period and amount of for each guarantee. Guarantees can take various forms but generally cover at least the loan payments to cover the construction costs. A guarantee clause can also include a provision for reimbursement to the municipality in case of deficit savings.

### ***Project Committee***

The contract should specify the person and authorities that would monitor the progress and implementation of project as per the agreement of contract.

Model Roles and Responsibility Chart/Table for the implementation of ESPC contract is mentioned below in Table 4.1 and it is only suggestive in nature (ESOLi 2013).

**Table 4.1: Roles and Responsibilities for Implementation of the Energy-Saving Performance Contract (ESPC)**

Responsible	Project Phases	
Client (municipality)	<b>Project Preparation</b> <ul style="list-style-type: none"> <li>• Inspection of data availability</li> <li>• Selection of lighting systems</li> </ul> 	
Client (municipality)	<b>Project Development</b> <ul style="list-style-type: none"> <li>• Constitution of steering committee</li> <li>• Evaluation of data/ Analysis of potential savings</li> <li>• Determination of operating cost baseline</li> <li>• Stipulation of system requirement</li> </ul> 	
Client (municipality)	<b>Tender</b> <ul style="list-style-type: none"> <li>• Compilation of tender document</li> <li>• Expression of Interest/ Request for Proposal</li> <li>• Call for tender</li> </ul> 	
Client (municipality)/ ESCO(service provider)	<b>1<sup>st</sup> Validation Stage</b> <ul style="list-style-type: none"> <li>• Validation of data sheet</li> <li>• Preparation of draft analysis</li> <li>• Submittal of offer</li> <li>• Valuation and determination of best offer</li> </ul> 	
Client (municipality)/ ESCO(service provider)	<b>Contract Negotiation</b> 	

<b>Client (municipality)/ ESCO(service provider)</b>	<b>Saving Guaranteed Contract (ESPC)</b>  ↓	
<b>ESCO(service provider)</b>	2 <sup>nd</sup> Validation Stage  ↓	Preparatory Phase  →
<b>ESCO(service provider)</b>	<b>Savings and Services</b>  →	Obligation to perform

Source: e-street Project Europe.

Source: Limaye 2013.

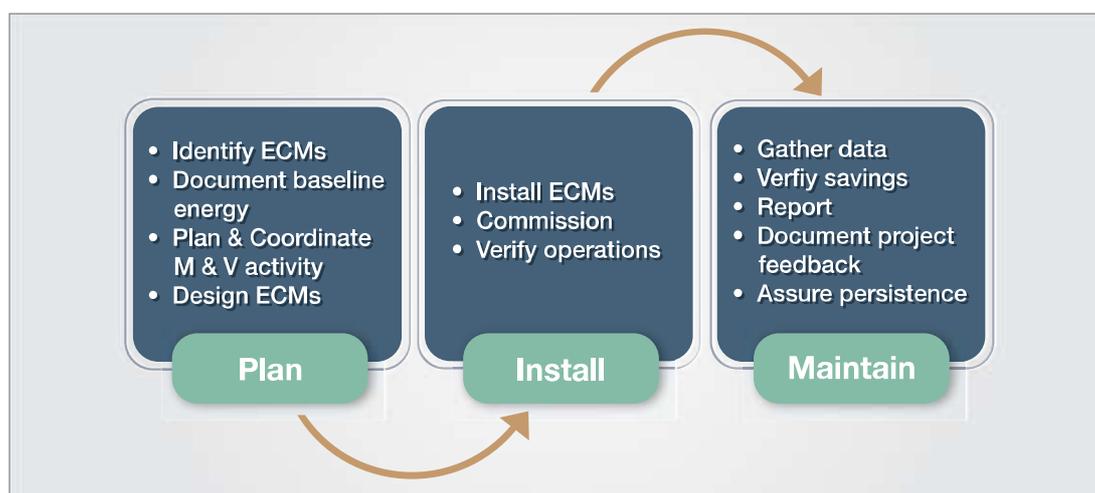
An outline of the template of the Performance Contract is provided in **Appendix D**.

## 5 SECTION 5: MONITORING AND VERIFICATION PROTOCOLS

The objective of measurement and verification is to quantify the energy savings resulting from implementation of energy conservation activities in a defined, disciplined, rigorous and transparent way. M&V planning is a critical step in the ESPC process.

The basic principle under M&V is to compare the measured energy consumption and demand before and after implementing Energy Conservation Measures (ECMs) to determine the energy savings. M&V is not just a collection of tasks conducted to help a project meet selected M&V guideline requirements, but also serves to enhance and improve facility operation and maintenance of savings. As shown in Figure 5.1, M&V activities overlap with other project efforts (for example, collecting data to both identify ECMs and establish energy baselines, commissioning and operationally verifying installed ECMs, and installing monitoring systems to track and maintain savings persistence). Identifying these project synergies and establishing roles and responsibilities of involved parties during project planning will support a coordinated team effort (NSW 2012).

**Figure 5.1: Process Pathway during M&V Activity**



Source: NSW 2012.

M&V plan is usually included in the energy saving performance contract. The elements of such a plan depend on the nature of the project and individual measures, which are mostly finalized only after the completion of the IGA. However, an illustrative list of key elements of a typical M&V plan would consist of the following:

- Description of energy conservation measures, intended results, and the “measurement boundary.” The measurement boundary is a “**notional boundary**” that defines the physical scope of an M&V project. The effects of an ECM are determined at this boundary, for example, “whole facility, subfacility, lighting circuit, mechanical plant room, switchboard, individual plant and equipment etc.”
- **Documentation of the facility’s base year conditions and energy data:**
- Identification of any planned changes to conditions of the base year;
- Identification of the post retrofit period;
- Set of conditions to which all energy measurements will be adjusted;
- Specification of M&V options and data analysis;
- Procedures, algorithms, and assumptions for performing the statistical validation and anticipated level of accuracy of measurement and results;

- Specification of software, budget, and resource requirements;
- Documentation and data available for another party to verify reported savings;
- Methods for making relevant baselines adjustments for unforeseen changes.

## 5.1 International M&V Guidelines

Measuring and verifying savings for a project/program requires special planning and engineering activities. There are internationally available M&V guidelines and protocols that have been used in undertaking M&V across projects globally.

M&V however, is an evolving science and each program needs customized M&V procedures. Industry best practices have been developed and the guidelines are presented in, “International Performance Measurement and Verification Protocols (IPMVP)” and “ASHRAE Guideline 14: Measurement of Energy and Demand.” In addition to these, there are other protocols that have been used globally. These include, Australasian ESPC M&V Guide, U.S. FEMP M&V Guidelines for quantifying the savings resulting from federal projects implemented using ESPC, the California Public Utilities Commissions EE valuation protocols and the CDM methodologies approved by the UNFCCC. Most of these protocols provide a range of M&V methods and approaches of varying degrees of complexity. IPMVP guideline is more extensively used around the world because of its robust framework.

### International Performance Measurement and Verification Protocol (IPMVP)

The IPMVP is a guidance document that provides a conceptual framework in measuring, computing, and reporting savings achieved by EE projects at facilities. The IPMVP defines key terms and outlines issues that must be considered in developing an M&V plan, but does not provide details for specific measures and technologies.

IPMVP was developed through a collaborative effort involving industry, government, financial, and other organizations, the IPMVP serves as the framework for M&V procedures, provides four M&V options, and addresses issues related to the use of M&V in third party financed projects.

### ASHRAE Guideline 14

ASHRAE Guideline 14: Measurement of Energy and Demand Savings is a reference for calculating energy and demand savings associated with performance contracts using measurements. In addition, it sets forth instrumentation and data management guidelines and describes methods for accounting for uncertainty associated with models and measurements. These guidelines specify three engineering approaches the three approaches are closely related to and support the options provided in IPMVP.

## 5.2 M&V Methodology for Energy-Efficient Street Lighting Program

The International Performance Measurement and Verification Protocol (IPMVP) provides a robust and comprehensive guideline to measure and verify the savings achieved from ECMs. The basic concept as explained in IPMVP is to determine energy or demand savings by comparing measured energy use or demand before and after implementation of an energy saving program.

$$\text{Energy savings} = \text{Baseline Energy Use} - \text{Post Retrofit Energy Use} \pm \text{Adjustments}^5$$

---

<sup>5</sup> Adjustment is used to bring energy use in the two different time periods to the same set of conditions.

There are two basic methods the retrofit isolation method and the whole facility method and each can be further subdivided into two options each.

**Option A:** Retrofit Isolation Method—Key Parameter Measurement

**Option B:** Retrofit Isolation Method—All Parameter Measurement

**Option C:** Whole Facility Method—Whole Facility

**Option D:** Whole Facility Method—Calibrated Simulation

Option D is not suitable for street lighting project hence Options A, B, and C are considered in this manual. Options A and B, that is, retrofit isolation, allow for narrowing the measurement boundary in order to reduce the effort required to monitor independent variables and static factors. This considerably reduces cost and effort associated with the M&V activities and is ideal for street lighting projects. (Refer to Table 5.1).

**Table 5.1: Options for Different M&V Methodology**

Option <sup>6</sup>	Savings Calculation	Example <sup>7</sup>
<p><b>Option A: Retrofit Isolation Method— Key Parameter Measurement</b></p> <p><b>Savings are determined by field measurement of the key performance parameters which define the energy use of the ECMs affected systems.</b></p> <p><b>Measurement frequency ranges from short term to continuous, depending on the expected variations in the measured parameter, and the length of the reporting period.</b></p> <p><b>Parameters not selected for field measurements are estimated. Estimations can be based on historical data, a manufacturer’s specifications, or engineering judgment. Justification of the estimated parameter is required.</b></p>	<p>Engineering calculation of baseline and reporting period energy from:</p> <p>Short term or continuous measurements of key operating parameters and estimated values</p>	<p>Savings are measured by comparing energy use before and after retrofitting. However the hours of use can be stipulated if the controls are manual.</p> <p>Here the performance is measured and the operation is stipulated.</p>

<p><b>Option B: Retrofit Isolation Method— All Parameter Measurement</b></p> <p><b>Savings are determined by field measurement of all the parameters of the energy use of the ECM affected system.</b></p>	<p>Short term or continuous measurements of baseline and reporting period energy or engineering computations using measurements of proxies of energy use.</p>	<p>If lighting controls are also included along with efficient lights the there is no point in estimating the hours of operations, as that would not allow measurement of the impact of the controls. Hence total consumption before and after the ECM should be measured and compared.</p>
<p><b>Option C: Whole Facility Method— Whole Facility</b></p> <p><b>Savings are determined by measuring energy use at the whole facility or subfacility level. Continuous measurements of the entire facility’s energy use are taken throughout the reporting period.</b></p>	<p>Analysis of the whole facility baseline and reporting period meter data.</p>	<p>If the street lighting project involves retrofitting various ECMs, including lights, power conducting units, dimming mechanism, and controls in this scenario, the ECMs have individual contributions to the total savings and also interacting effect. In this case whole facility approach is needed.</p>

Source: IPMVP (EVO 10000–1: 2012).

Measurement and verification pose many challenges in themselves and have been a reason for conflict between the client and energy service companies. Some very common issues associated with M&V are listed below, many of these challenges are specifically relevant to EE street lighting projects or in India’s context.

1. M&V increases the project cost anywhere between 1% and 10% of the total project cost.
2. In many cases energy service companies are not equipped to perform M&V.
3. In many scenarios, EE improvements result in increased energy consumption because lot of nonworking equipment is replaced. If proper baseline adjustment is not carried out this may result in conflict.
4. For street lighting projects where the savings can pretty consistent, M&V tends to increase the project cost with little added advantage.

In order to avoid the issues associated with conventional M&V approaches that may hamper the implementation of EE street lighting projects; Energy Efficiency Service Limited (EESL) India has devised its own innovative approach which they have successfully used for implementing many projects across India. EESL employs annuity-based ESCO model and uses deemed savings for M&V purposes.

The EESL has evolved an annuity-based ESCO model that could ensure the best available technology to be retrofitted with an overall cost saving to the ULBs. The model divorces the requirement of periodically demonstrating energy and cost savings to get the returns on investments. The cost saving is reckoned from the combined expenditure of ULB on electricity bill and O&M charges.

#### **Energy Efficiency Services Limited (EESL)**

EESL has been setup by Ministry of Power (MOP), Government of India, as the implementation arm of (MOP) Ministry of Power and (BEE) Bureau of Energy Efficiency. EESL acts as a Super ESCO in India. EESL has been widely successful in implementing EE Street Lighting Projects through its Annuity based ESCO model.

### **5.3 Who Conducts the M&V?**

Usually, public agencies have lacked the capacity to conduct a formal M&V and the energy service provider has thus been responsible for it. Examples include Canada and the United States. However, some recent ESPCs in developing countries have required third-party M&V, conducted by highly qualified

organizations that specialize in it. The rationale for using a qualified third party is that this option is likely to reduce the possibility of disputes related to satisfaction of the performance guarantees and measurement of actual savings achieved. In South Africa, for example, Eskom, the national electric utility, has assembled a panel of seven preapproved M&V organizations (all university based), and all ESCOs participating in the Eskom EE and DSM program are required to use one of those organizations. In India, recent ESPCs in municipalities have employed third-party M&V agents (usually NGOs or other ESCOs). The IFC *Manual for the Development of Municipal Energy Efficiency Projects* suggests that “an independent expert or service company, not affiliated with any of the contract parties, performs M&V in order to ensure unbiased verification of the achieved savings” (Alliance to Save Energy 2008).

Regardless of who conducts measurement and verification, it must be done in accordance with the M&V plan specified in the ESPC. Although the RFP may contain a draft plan, the ESP should be required to submit a more detailed one in the proposal and a final plan once the IGA has been completed and the detailed ESPC provisions negotiated. The specific elements of the M&V plan will depend on the nature of the project and individual measures, which is why it is typically finalized only after the IGA. An important element in the M&V process is the definition of the baseline, which defines the pre implementation conditions against which the savings (or other specified performance parameters) are calculated.

It is important to include in the M&V plan specific provisions regarding what changes would require changing the baseline, how such changes will be identified and tracked, and how the baseline should be modified in case such changes occur. If the project includes carbon financing, any CER revenue shortfalls as a result of project performance must also be assigned in the final ESPC.

The frequency of conducting M&V depends on the project and is negotiated as a part of the M&V plan included in the contract. The frequency may vary from a one-time measurement, to monthly, quarterly, or annual measurements. The ESPC will also specify who will bear the cost for the M&V. When the M&V is conducted by the public agency or a third party engaged by the agency, the cost is generally borne directly by the agency. But, when the ESP conducts the M&V or engages a third party, the cost is often **included in the ESP’s project costs**.

## 6 SECTION 6: TOOLS AND MATRIX

This section of the manual is focused to help ULBs or municipalities to design effective contract and help them with through due diligence process. Three matrices are discussed in this section for self-analysis by municipalities while implementing EE in street lighting projects.

- **Financial and Economic Analysis Tools** helps in evaluating financial and economical viability of the proposed project. Also, Lifecycle cost analysis have discussed in brief to assist ULBs in deciding total net benefits out of their proposed energy conservation measures in the street lighting projects.
- **Project Appraisal Matrix** assists the ULBs by providing them with self-assessment matrix to evaluate its conditions of the current infrastructure, capacity and brief discussion about the project variability (that is, economical, technology specific and energy savings through proposed interventions).
- **Vendor Qualification Matrix** provides an assessment tool for the ULBs to evaluate Vendors before awarding them with the contract to implement the project as per the performance contract.

### 6.1 Financial and Economic Analysis Tool

Financial viability of the project is an important parameter to judge the direction of the project. It is important tool to prepare initial estimates to undertake such projects. Also, it is required for an approach to Financial Institutions for commercial lending program. Tables 6.1 and 6.2 show the indicative summary for the Financial Tool used in EE street lighting project.

This tool will be useful for the ULBs or municipalities administration to analyze the financial feasibility of the proposed initiative. It explores financial and economic viability of the project and looks into the possibility of how to finance the project.

This tool requires certain input and assumption from the project proponent to analyze key performance indicators for the assessment of the project. It is important to note that this tool will be used at the earlier stages of the project design or conception. So, it is required to carefully assess the requirement of the project and its financial projections. This is also important as the tool findings will help ULBs to approach Financial Institutions for lending and help in making correct decision about the approach or model of financing these projects.

With the help of this tool, ULBs will be able to assess the key points before taking decision with the respect to project feasibility;

- Total investment required.
- Capital cost of the EE equipment.
- Capital cost of the O&M and M&V.
- Initial tentative energy savings estimates from implementation of the project.

**Table 6.1: Summary for the Cost Analysis under Financial Tool**

Assumptions	Unit	Value
<b>Tariff Cost</b>		
Tariff		
Tariff Escalation Rate		
<b>Capital Cost</b>		
Excise Duty		
CST		

<b>Transportation Cost</b>			
<b>Erection Cost</b>			
No. of years for debt	<b>Interest and Debt</b>		
<b>Interest Rate</b>			
<b>Equity as a % of total costs</b>	Total Investment Required (Lakhs Rs)		
	Total Equity (Lakhs Rs)	<b>Recurring Cost</b>	
<b>Corporate Tax</b>	Total Debt (Lakhs Rs)		
<b>Manpower Cost Escalation</b>			
<b>Repair and Maintenance Cost</b>			
<b>Repair and Maintenance Cost Escalation</b>			
<b>Depreciation Rate</b>			
<b>Calibration Cost of M&amp;V Equipment</b>			
<b>Escalation in Calibration Cost of M&amp;V Equipment</b>			

Source: Author.

**Table 6.2: Indicative Table for Financial Analysis of EE Street Lighting Project**

Particulars	Years	0	1	2	3	4	5	6	7	8	9	10
Capital Cost of Lamps along with lighting controls (in lakhs)												
Capital Cost of SCADA and M&V Equipment (Lakh Rs)												
Tariff, Rs/ Unit (Annual Tariff with CAGR included)												
Energy Saved (Lakh kWh/annum)												
Total Saving (Lakh Rs)												
Revenue (Share of ESCO in savings), in Lakh Rs												
Manpower Cost (Lakhs Rs)												
Repair and Maintenance Cost of LED Fixtures (Lakhs Rs)												
Annual GPRS Connectivity Charges (Lakhs Rs)												
Annual Calibration Cost of M&V Equipment (Lakhs Rs)												
PMC Cost												
M&V Cost												
Total Expenditure (Lakhs Rs)												
Interest on Debt (Lakhs Rs)												
Earnings Before Tax (Lakhs Rs)												
Depreciation Cost (Lakhs Rs)												
Taxable Earning (Lakhs Rs)												

Tax (Lakhs Rs)											
Net Cash Flow (Lakhs Rs)											
Cumulative Cash Flow (Lakhs Rs)											

Project IRR	
Payback in Years	

Source: Author.

### Life Cycle Cost Analysis (LCCA)

LCCA is useful to compare alternative measures that fulfill the same requirement, but differ with respect to initial costs and operating cost. LCCA is a method for assessing the total cost of project, that is, the cost of acquiring, owning, and disposing the street lighting project.

LCCA should be performed early in the design process while there is still a chance to refine the design to ensure reduction in life cycle cost. Numerous costs are associated with acquiring, operating, maintaining, and disposing of a street lighting system. Project-related costs usually fall into the following categories:

- Initial Cost
- Fuel Cost
- O&M/Repair Cost
- Replacement Cost
- Residual Value—Resale/Salvage/Disposal
- Financial Charges—Loan Interest Payments
- Non-Monetary Benefits or Costs

### LCC Calculation

$$LCC = I + RepI - Res + E + W + OMR + O$$

LCC = Total LCC in present value

I = present value investment cost

Repl = present value capital replacement costs

Res = present value residual cost

E = present value of energy cost

W = present value of water cost

OM&R = present value nonfuel operating, maintenance and repair cost

O = present value other cost

LCCA can be applied to any capital investment decision in which relatively higher initial costs are traded for reduced future cost obligation. LCCA provides a significantly better assessment of long term cost

effectiveness of a project than alternative economic methods that focus only on first costs or on operating related costs in the short run.

## 6.2 Project Appraisal Matrix

It is important for the decision makers in the public sector (that is, ULBs and the Public sector) to check the feasibility of the proposed project and conduct proper due diligence in this regard. Table 6.3 provides a matrix for the ULBs to check the feasibility of the project.

Project appraisal is the process of assessing and questioning proposals before resources are committed. It is a means by which stakeholders can choose the best projects to help them achieve what they want for their ULB or municipality. Project appraisal is a requirement before funding of programs is done.

The project appraisal matrix prepared as part of this manual will help in assessing and answering important questions on:

- a. Current infrastructure and conditions
- b. Capacity of stakeholders
- c. Project Size
- d. Technology Specifics
- e. Project Feasibility

Project Appraisal justifies spending money on a project. Project Appraisal includes asking fundamental questions about whether funding is required and whether a project offers good value for money. The appraisal matrix is an important decision making tool with comprehensive analysis of a wide range of data, judgments and assumptions, all of which need adequate evidence. The project appraisal matrix will help the decision makers to:

- Be consistent and objective in choosing projects
- Make sure their program benefits all stakeholders
- Provide documentation to meet financial and audit requirements and justify the uptake of the project

**Table 6.3: Project Appraisal Matrix**

S. N.	Criteria	Description (Indicative)	Comments
1.	<b>Current conditions of infrastructure in proposed project</b>		
	• Technology and Control	Manual/Semi-Automatic/Fully Automation and LED/MVP/T8	
	• Road Conditions/Traffics	High Traffic/Medium Traffic/Low Traffic	
	• Nonworking Lights/ Switch Point		
	• Inventory of the Lights/Switch Points		
	• Safety Level as per the prescribed Indian standards	Yes/No	
2.	<b>Capacity of ULBs or a municipal corporation</b>		
	• Availability of Staff/Human Resource	Adequate/Not Adequate	
	• O&M Capacity	Adequate/Not Adequate	
	• Financial Capability of ULBs/MC		
3.	<b>Size of Project</b>		

	<ul style="list-style-type: none"> <li>No. of Lighting Retrofits proposed</li> </ul>		
	<ul style="list-style-type: none"> <li>Road and Project area covered under the proposed project</li> </ul>		
4.	<b>Proposed Technology</b>		
	<ul style="list-style-type: none"> <li>Lights</li> </ul>		
	<ul style="list-style-type: none"> <li>Controls and Automation</li> </ul>		
5.	<b>Energy Savings</b>		
	<ul style="list-style-type: none"> <li>kWh/Year</li> </ul>		
	<ul style="list-style-type: none"> <li>Green House Gas emission reductions</li> </ul>		
6.	<b>Project Cost</b>		
	<ul style="list-style-type: none"> <li>Retrofit Cost</li> </ul>		
	<ul style="list-style-type: none"> <li>M&amp;V Cost</li> </ul>		
	<ul style="list-style-type: none"> <li>O&amp;M Cost</li> </ul>		
7.	<b>Payback Period</b>	3-5 Years or 5 >	
8.	<b>Financial Model Proposed</b>	Self-financed or ESCO (shared or guaranteed savings) or annuity-based, deemed saving model	
9.	<b>Project Feasibility</b>	Positive or negative	

Source: Author.

## 6.3 Vendor Qualification Matrix

Sourcing and awarding the work contract to right vendor and agency is very important for the success of the project implementation. Below is the indicative matrix of the vendor qualification (Table 6.4).

Vendor qualification is the process of assessing and contracting the right vendor for the project. It is very important to ensure early and adequate communication with the vendors and service providers about the upcoming business opportunities through EOI or RFP. The vendor qualification matrix has two tier benefits, one during the RFP preparation stage in the form of guidance to create a robust RFP and second during the vendor selection to rate different service providers and then selecting the right vendor. It is a means by which stakeholders can choose the best service provider to help successful project implementation.

The vendor qualification matrix prepared as part of this manual will help in assessing

- a. Vendor Organization Capability
- b. Vendor Technical Capability
- c. Vendor Operational Capability
- d. Vendors Financial Health

The vendor qualification matrix helps in justifying the vendor selection process and keeps the entire process transparent. It is an important decision making tool with comprehensive analysis.

**Table 6.4: Vendor Qualification Matrix**

S. N.	Criteria	Yes/No	Remarks(Indicative)*
1.	<b>Organization Capability</b>		
	<ul style="list-style-type: none"> <li>Short Description of Organization/Associates/ Partners capability</li> </ul>		
	<ul style="list-style-type: none"> <li>Brochure (If Required)</li> </ul>		

	<ul style="list-style-type: none"> <li>Organization Structure</li> </ul>		
	<ul style="list-style-type: none"> <li>Pending litigation (If Any)</li> </ul>		Yes then Disqualified
	<ul style="list-style-type: none"> <li>Partnerships</li> </ul>		JV Allowed or Not
<b>2.</b>	<b>Technical Capability</b>		
	<ul style="list-style-type: none"> <li>List of Similar Projects (Size and Capability)</li> </ul>		For example :At least 2 projects in last 3 Years of similar size Or Cumulative number of projects to assess the capacity of organization to implement projects of particular size
	<ul style="list-style-type: none"> <li>List of projects to showcase exposure in government and public sector</li> </ul>		For example: Experience of working with Public sector experience in last 3 years
	<ul style="list-style-type: none"> <li>List of Human Resource</li> </ul>		Minimum No. Project Manager (Engineer and MBA: more than 8 Years Exp) Certified Energy Auditors Sr. Engineer (5–8 Yrs Exp) Engineer (2–5 Yrs Exp)
<b>3.</b>	<b>Operational Capability (Understanding of Project Objectives)</b>		
	<ul style="list-style-type: none"> <li>Approach and Methodology</li> </ul>		
	<ul style="list-style-type: none"> <li>Detailed CVs of important Human resource employed in the project</li> </ul>		Yes/No
	<ul style="list-style-type: none"> <li>Timeline and Project Schedule</li> </ul>		Yes/No
<b>4.</b>	<b>Financial/Economical Capability</b>		
	<ul style="list-style-type: none"> <li>Audited Balance Sheets</li> </ul>		For example, Minimum 5 Cr Turnover at least twice in last 3 years Or Net worth of a minimum of 25% of the project cost
	<ul style="list-style-type: none"> <li>Organizational Incorporation and Registration</li> </ul>		Yes/ No
<b>5.</b>	<b>Adherence to EoI/RFQs instructions</b>		Yes/No

\*The performance parameters are discussed in the remarks column to provide with an indicative list of some if the parameters for qualification matrix above.

Source: Author.

India: EESL follow GoI CVC's procurement guidelines for setting up performance parameters. Similarly, other countries' organizations should be following their own procurement guidelines.

## 6.4 The SEAD Street Lighting Tool

The Clean Energy Ministry's [SEAD Initiative](#), with support from *CLASP*, is working with city governments and local partners to train municipalities on the use of SEAD's [Street Lighting Tool](#) to identify energy

efficient and cost-effective options for upgrading streetlights. *This tool provides tools to the administration in designing efficient street lighting projects.* The SEAD Street Lighting Tool is a free, easy-to-use calculator that helps municipal officials make more informed procurement choices and alleviate some of the complexity involved in purchasing new street lighting products.

**SEAD Street Lighting Tool v1.7.1**

Previous 1 Describe Road 2 Set Lighting Targets 3 Choose Fixtures 4 Identify Costs 5 Confirm Inputs Next

Road geometry inputs describe the size and shape of the road section, as well as the placement and size of poles. Enter values for both baseline and upgrade. If you are replacing fixtures only, enter the same values in both columns.

Description:	Baseline	Upgrade	Units
<b>Road Geometry</b>			
Number of Lanes			Lanes ?
Lane Width			meters ?
Median Width			meters ?
<b>Light Geometry:</b>			
Pole Placement			? ?
Luminaire Mounting Height			meters ?
Pole Spacing			meters ?
Pole Setback			meters ?
Arm length			meters ?

Pavement Type (only required for luminance calculations)

Start Road Geometry Lighting Standards Fixtures Costs Confirmation Delete IES Add IES Files MResults Info CostCalcs

**Figure 2: Snapshot of SEAD Street Lighting Tool**

For more details on the SEAD Street Lighting Tool, please visit [www.superefficient.org](http://www.superefficient.org).<sup>8</sup>

<sup>8</sup> [http://superefficient.org/Products/-/link.aspx?\\_id=1550F9BAA57C4E0ABC2492EF3E032500&\\_z=z](http://superefficient.org/Products/-/link.aspx?_id=1550F9BAA57C4E0ABC2492EF3E032500&_z=z)

## 7 SECTION 7: TRAINING AND CAPACITY BUILDING

### 7.1 Capacity Building Needs of EE Street Lighting Stakeholders

Clearly, successful implementation of EE in street lighting is dependent on several stakeholders involved at various stages of street lighting projects. The individual capacity of each of these stakeholders in implementing EE in street lighting as well as coordination/collaborations amongst them greatly determines the effective implementation.

This section of the manual focuses on classifying the stakeholders according to their role in implementation of street lighting projects in India. It also highlights the need for designing effective capacity building programs and provides indicative components of capacity building programs.

The concerned stakeholders in implementing EE in street lighting can be classified into following categories:

- *Policy and Regulatory Institutions:* these consist of national, state and city level organizations which shape policy and provide the regulatory environment around which street lighting projects are implemented. The role of these organizations is extremely crucial in shaping the overall environment for facilitating implementation of EE in municipal projects. It is also important for creation of platforms which enables interaction of policy makers and regulators with other concerned stakeholders to ensure reflection of stakeholder concerns in government EE policies and programs.
- *Implementation Agencies:* in the street lighting space these consist of ULBs and municipal corporations which are the primary agencies responsible for implementation of EE in street lighting. Their role is of paramount importance and it is extremely crucial for them to have right capacities for addressing various aspects of EE implementation projects.
- *Service/technology providers:* these agencies consist of energy services companies, equipment manufacturers, distributors, vendors and suppliers. A well-established network of service and technology providers can go a long way in smooth implementation of street lighting projects. A better understanding and awareness of technology providers of various EE implementation models can greatly facilitate the implementation.
- *Enablers:* this represents a distinct group of stakeholders which act as enablers in EE implementation projects. These consist of banks and financial institutions, which provide the requisite financing over and above the ULB budgets. Enablers also consist of organizations such as research institutes, training and capacity building organizations which can facilitate in transition to an energy-efficient economy. Role of international organizations such as multilateral and bi-lateral organizations operating in India, also help in building capacity of various stakeholders in implementing EE in the country.

Stakeholder engagement is a crucial component of an overall EE governance system. Stakeholder engagement helps build political consensus and ensures broad buy-in to policy implementation. That is not to say that stakeholder engagement is not without its risks, and it is a process which should be actively and carefully managed (IEA2010).

Also, engagement with all the relevant stakeholders ensures and creates positive environment which serves as a basis for forging effective and equitable partnerships. Dialogue can help uphold principles of transparency and accountability, and forge relationship built on trust and mutual responsibility.

## 7.2 Stakeholder Capacity Building

As mentioned before, capacity building and knowledge management are the most important component for the successful implementation and management of EE street lighting projects. Experience in India and other markets in financing EE Street Lighting demonstrates that not only do capacity-building programs significantly amplify the impact of projects, but they are also in fact crucial for the success of the projects. Lack of knowledge and capacity creates higher transaction costs per unit of savings and has proved to be a major barrier to achieve best results in the past. Public and private stakeholders/ULBs require knowledge building on a range of issues, including a basic understanding of EE concepts, specialized technical financial and legal understanding, standardized contracts and legal structures, operation and maintenance and monitoring and verification protocols. This understanding will allow ULBs to effectively assess the risks and returns of projects, structure financing, and develop effective program design, implementation and monitoring strategies.

In order to develop a sustainable energy-efficient street lighting project, capacity building for ESCOs that banks can partner with is also important. ESCOs can handle the technical aspects and development and implementation of the projects. Currently there is very little technical or financial data available in **India's market for ESCOs working on EE Street Lighting**, or for ULBs to rely upon and utilize to structure projects. These players need better knowledge and understanding of the market, including data on domestic technologies. They would benefit from internationally developed models for financial and technical contracts, and standardized auditing procedures that produce investment-grade audits. Making these more widely available, and providing necessary training for their use, will strengthen the ability of all project developers to successfully finance a project. Lastly it is also important to provide information and training to the ULBs, which currently receive little information on the benefits of EE.

## 7.3 How to Design Capacity Building Programs

1. **Capacity-building training materials** should be developed for public and private banks, ESCOs, ULBs and end-users for delivery to and dissemination by stakeholders. The training material should communicate basic EE financing knowledge as well as the information gathered on technical, managerial and monitoring aspects, and include: ULBs basic training material and booklet, commercial banks basic training materials (to be tailored for each); utilities basic training materials and booklet, ESCO/technician basic training materials for investment grade audits and best standards.
2. **Contract Templates** should be developed using existing successful contract structures with service providers and GOI and tailored for the ULBs requirements including financial and legal requirements. These include loan agreements and energy savings agreements, and are to be used as a template or base in order to facilitate future transactions. These Standard Contracts should be distributed and made available to stakeholders along with other materials (an indicative outline for some of the contracts and documents is included in the appendixes to this manual).
3. **Monitoring, Evaluation and Dissemination** protocols and procedures for project data should be developed and shared with ULBs, ESCOs, utilities, banks and other stakeholders. This will help in gearing up to track the success of the program, and make economic and qualitative data available to players in the market, including ULBs, ESCOs, technicians, and banks, on the projects. This comprises on-going tracking and reporting, gathering and organization, analysis, and delivery and dissemination of data from SMEs, ESCOs and banks.
4. **Communication and Dissemination** of all the training and capacity building materials should take place, through cooperation with stakeholders. Materials shall be made available through the existing online portals of Service providers, ULBs and other stakeholders.

5. **Workshops and Study Tours** of focused stakeholder or group is an important tool to engage and facilitate knowledge exchange among the stakeholders in the various regions. This also enable focused group to learn from success and failures of the similar projects across the region and can built into their policy learning process. Henceforth, relevant officials and stakeholders should be engaged in the cross-regional workshops and seminars and this could be further broadened with study trip to get necessary exposure from live projects.
6. **Capacity-building events for ESCOs/technicians/ULBs** should be organized on a regular basis to provide targeted training on conducting audits, developing baselines, program design, financing, implementation, repair and maintenance and monitoring. ESCOs/technicians/ULBs should also be trained through events taking place in partnership with utilities, vendors, technology providers, and financing institutions. They should receive capacity building materials and basic training courses on EE benefits and opportunities. Training materials for technical components should also be developed with the help of vendors, technology providers and ESCOs to maximize their potential for wide dissemination to different stakeholders EE agencies, and/or other industry partners
7. **Training the trainers** is an important program, which aims at the equipping the local industries, stakeholders, ULBs/ministry officials and EE experts with the expertise, methodologies and tools require to develop and implement energy management system for optimization of the projects and practices. This is important, since it prepares and gives exposure to practitioners in the EE industry through study visits, knowledge exchange programs, and workshops at various levels. Study visit can be arranged with international institutions and country programs for the better understanding and exposure to the industry's best practices.
8. **Standard Documents** to be developed for the capacity building and knowledge management could be listed as under:
  - a. Modular EPC model contract document
  - b. Guidelines on technology procurement
  - c. Guidelines on collaboration with private sector and other partners
  - d. Guidelines on environmental, social and occupational health and safety issues
  - e. Stakeholder engagement strategy
  - f. Project management technique
  - g. Quality control matrix
  - h. Large-scale project development strategy
  - i. Stakeholder database
  - j. Key policy considerations
  - k. Subscription to leading e-resources
  - l. Mapping of external and internal risk environment and risk awareness and management guidelines

## 8 SECTION 8: SELECT CASE STUDIES ON STREET LIGHT ENERGY EFFICIENCY

### 8.1 International Case Studies

#### 8.1.1 United Kingdom—Private Finance Initiative (PFI)

The United Kingdom (UK) has been at the forefront for developing innovative approaches to engage the private sector in the delivery of public services. In 1992 the UK embarked upon a new type of public-private partnership, known as the Private Finance Initiative (PFI). Under the Private Finance Initiative, private sector firms take on the responsibility of providing a public service including maintaining, enhancing or constructing the necessary infrastructure required. This model is similar to traditional ESCO (PPP) model for public services in the space of EE. UK government since the inception of PFI in 1992 has successfully tried this model into various public service domains, to bring private investment and expertise in enhancing their public service delivery mechanism (House of Commons 2011).

#### Case Study: The Surrey Street Lighting PFI initiative (United Kingdom)

Surrey county council initiated one of the largest street lighting modernization program under the Private Finance Initiative (PFI), to design, build, finance, and operate the street lighting system of the entire county by the private player, that is, Skanska Laing Consortium. The Surrey Street Lighting PFI initiative involved **modernizing the County of Surrey's** entire street lighting system to provide higher quality and more efficient street lighting for 25 years.

**Prior to the project, Surrey's lighting stock had suffered years of insufficient investment, and much of the stock had reached the end of its design life and was becoming increasingly expensive to maintain.**

Almost 40 percent of the columns before the project were installed during or prior to the 1960s, including 2,600 columns from the pre-1950s. Many lighting columns had been rendered unsafe because of internal corrosion and only 17 percent of the pre-project lighting columns complied with modern safety and lighting design standards. Many of the aging lamps were also inefficient and produced inadequate lighting, in some cases operating with half their original illumination (SKANSKA 2011).

The Skanska consortium is conducting the US\$202 million PFI for Surrey County Council and is responsible for **modernizing and maintaining Surrey's**

street lighting from 2010 to 2034. Skanska Infrastructure Services is the sole service provider and are responsible for managing the entire project. The project will replace inefficient orange and yellow lamps with energy-efficient white light sources, and install steel columns in place of old concrete and iron lamp posts. An initial survey was conducted in the first year of the project, which collated structural, lighting and column life expectancy data for the **county's** entire street lighting stock in a management information system (MIS). All the **county's** 89,000 streetlights will be modernized in the first five years of the project, including 70,000 column and lamp replacements, and 19,000 lamp replacements for relatively new columns. The columns are being replaced on a one-for-one basis, and whole districts will be upgraded simultaneously. A Central Management System (CMS) has been installed, which consists of monitoring

Duration	25 Years
<b>Implementation/ Procurement Model</b>	<b>Private Finance Initiative (PFI)</b> <ul style="list-style-type: none"> <li>• A long-term contract integrating design, build, finance, O&amp;M.</li> <li>• All costs are included in a "unitary" payment, which is fixed over the life of the contract.</li> <li>• The capital cost of the construction is financed by the private sector borrower and cost is amortized over the life of the project.</li> </ul>
<b>Payment Model</b>	<b>Unitary Charges</b> (The unitary charge payments are linked to a performance regime. Deductions may be made if services are not delivered to contractual requirements.)

and control equipment on every lighting column that communicates via encrypted mobile phone technology to a control center near Guildford. The system monitors individual lamp lighting performance and energy use, allows lamps to be remotely dimmed and controlled, and can help to automatically identify or predict lamp failure (SKANSKA 2011).

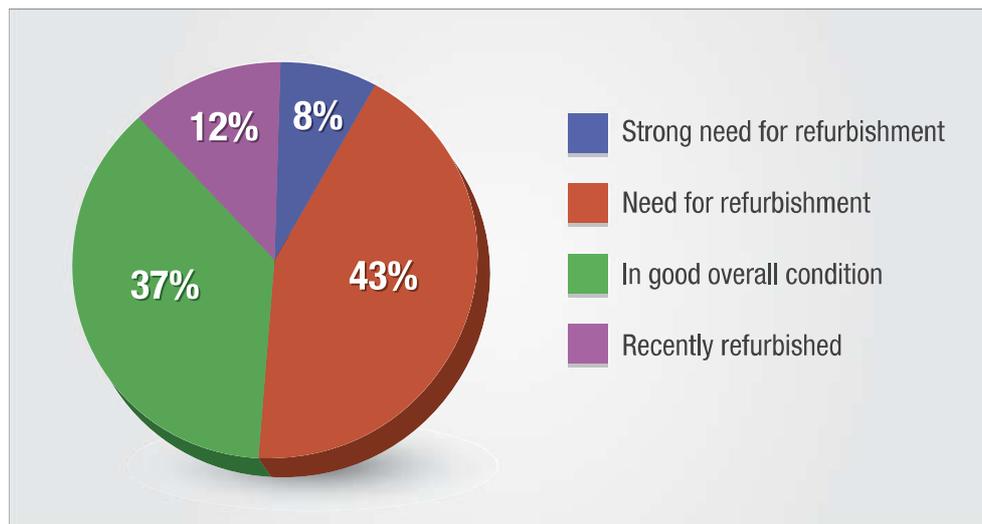
Under this model (that is, the Private Finance Initiative), the responsibility for street lighting, traffic sign maintenance and design will be transferred from the Council to a private sector operator, known as the Public Service Provider for 25 years. The Council would then pay an annual unitary charge to the contractor for the duration of the contract in exchange for the provision of the street lighting service, and would receive a contribution from DfT to support this in the form of PFI credits. PFI Credit is cash paid to a Council by the Government to offset the unitary charge / contract payment to the external private contractor during the life of the contract. The credit is calculated to cover the capital financing costs of the major investment that takes place in the first 5 years of a PFI street lighting contract (SKANSKA 2011).

Here large infrastructure companies take up street lighting installation and maintenance on prescribed energy-efficient technologies.

### 8.1.2 Street Lighting in Germany

Although the German government is actively promoting EE street lighting through various integrated grants and programs, the conventional public lighting system in Germany is responsible for almost 3–4 trillion kWh, and public lighting in Germany accounts for almost 50% of the electricity bill of any municipality. Almost one third of points in the country are older than 20 years and have a very slow retrofit rate of only 3% per year. A European Parliament and Council Directive on this issue (2009/125/EC) outlines eco-design requirements for energy-using products, focusing on energy consumption during the entire product lifecycle including production, transport, scrapping and recycling. One aspect of the directive is the phasing-out of high-pressure mercury lamps (HPM) by 2015 and of medium efficient metal halide lamps by 2017. This directive will act as the catalyst to encourage investments in the industry (Thermann 2014).

<p><b>Germany street lighting space is still at an early stage of development. Pilot projects in the space of public private partnership in this space are still being developed. Duration (Payback Period)</b></p>	<p><b>10 Years</b></p>
<p><b>Implementation/Procurement Model</b></p>	<p><b>Public Procurement:</b> Direct procurement by the public agencies on fixed fees basis for installation and commissioning of the fixtures and lighting infrastructure.</p>
<p><b>Payment Model</b></p>	<p>Soft loan (that is, low interest, 0.88%) provided by the KfW for the municipalities to implement EE street lighting project as per the EU directive.</p>



**Figure 8.1: Technical Condition of German Lighting in German Municipalities**

*Source:* Elbing 2011.

A recent study by the leading bank in Germany identified financing and low priority as the critical barriers for the sector. To overcome these barriers and accelerate the deployment of the EE street lightings in the country, German government devised a three-stage program in 2008. As indicated in the table 6.4, KfW is actively promoting this initiative of encouraging EE street lighting in the German municipalities. German municipalities can access these loans by submitting an application to KfW. Municipalities generally are burdened with critical budget situations and high power consumption along with the high electricity tariffs which makes this situation worse. Most municipalities are grappling with the issues of low penetration of retrofits. These loans can be applied directly with maximum tenure of 10 Years and fixed interest rates for tenure. The effective rate of interest is currently at 0.88% as per September 2013. A case study from City of Norden, Germany, where the municipal body implemented EE street lighting, showcases that they were able to achieve substantial energy savings (approx. 50%)(Elbing 2011).

The Federal Ministry for Environment, under the German Government provides a similar support to municipalities. Within that program, LED outdoor and street lighting has been funded by a grant of 40 % of the eligible costs in 2011 which was reduced to 25 % in 2012 and a further reduction to 20 % for the last funding period in 2013. Timeline for the program is explained in the Table 8.1 below. Projects have received the support if they prove to reduce energy consumption by 60% and if they include control systems (Elbing 2011).

**Table 8.1: Accelerating Deployment of EE Street Lighting in Germany**

Phase 1: Competition	Phase 2: LED Demonstration Project	Phase 3: KfW Loan Programme
<ul style="list-style-type: none"> <li>• 2008 – 2013</li> <li>• Financing of the most interesting 43 small/ medium scale schemes in 18 municipalities out of over 400 applications after evaluation by a committee</li> <li>• 2 stages: 1) technology, 2) municipalities</li> <li>• Grant element 30 %/ 25 %</li> </ul>	<ul style="list-style-type: none"> <li>• 2009 – 2013</li> <li>• LED based projects with at least 50 % energy savings and significant improvement of quality</li> <li>• Financing of concept development and implementation with grants of 25 % (2012)</li> </ul>	<ul style="list-style-type: none"> <li>• Special low-interest loan programme for municipalities introduced by KfW in 2012</li> </ul>

Source: Thermann 2014.

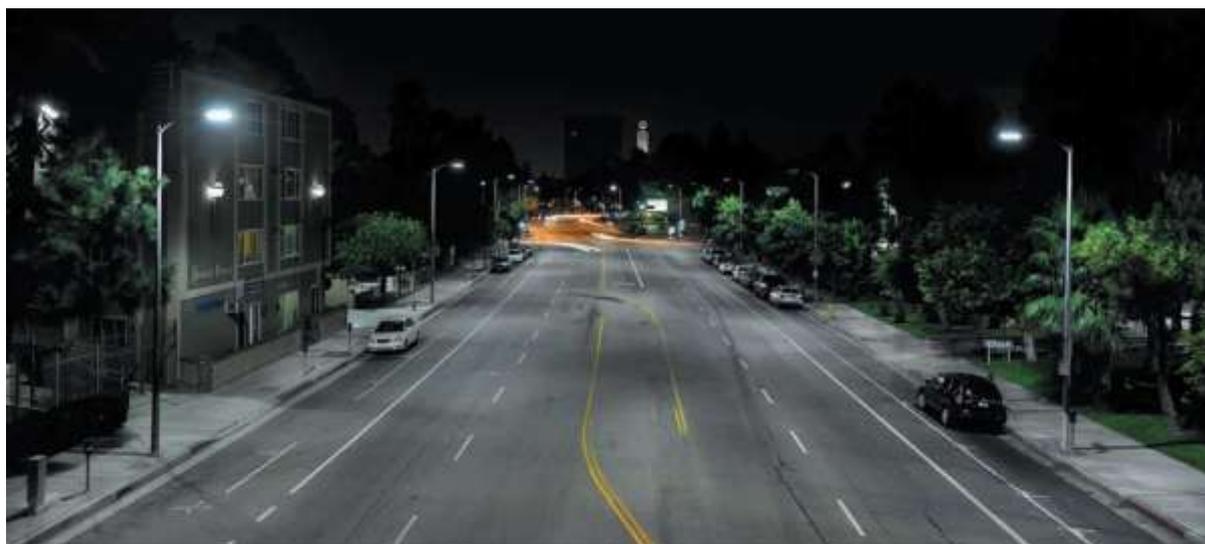
**Table 8.2: Key Features from the Case Study of City of Norden (Ostfriesland)**

Before modernization:	After modernization:
<ul style="list-style-type: none"> <li>&gt; High pressure mercury lamps (80 W)</li> <li>&gt; Standard Control</li> <li>&gt; Partial light level reduction</li> </ul>	<ul style="list-style-type: none"> <li>&gt; LED (26 W) → 70% energy savings</li> <li>&gt; Single light point control</li> <li>&gt; Presence detector → 30-35% savings</li> </ul>
 <p>Source: Stadt Norden</p>	 <p>Source: Stadt Norden</p>

Source: Stadt Norden.

Other forms of PPP models are also being tested in Germany. Many pilot projects have been tested and for this purpose OPP Deutschland AG has published procurement package for street lighting in Germany. As PPP model in Germany is relatively new, full-scale implementation of ESCO or PPP models are not as prominent there as compared to United Kingdom, where they have successfully implemented PPP models since 1992 (Thermann 2014).

### 8.1.3 City of Los Angeles, United State of America



Source: CREE Project Flyer.

The City of Los Angeles is one of the pioneering city administrations to uptake and complete one of the largest EE street lighting projects in the world. This is the one the most successful cases for EE street lighting proponents.

The Los Angeles Street Lighting System had 140,000 streetlights that used approximately 197,000,000 KWH per year. Energy costs were a real concern.

Street Lighting maintenance is primarily funded from the Street Lighting Maintenance Assessment Fund (SLMAF), which generates US\$42 million dollars annually. This fund covers all costs associated with the operation and

maintenance of the city's street lighting system, including energy cost, material, labor, fleet, and cost for other city entities support. The SLMAF has been frozen since 1996 with the passage of Proposition 218, which hampers the city's ability to adjust the fund to correspond with the inflation index without directly going to the voters for that authority. Meanwhile, the operational cost of the implementing agency has continued to increase. In 2007, the implementing agencies current expenditures totaled US\$52 million annually with approximately US\$15 million for electricity paid to the Department of Water and Power (DWP). This situation led to a projected future deficit for the continued operation and maintenance of the city's street lighting system (Ebrahimian 2009).

The program is funded through a loan, energy rebate, and the Street Lighting Maintenance Assessment Fund. The loan debt service payments will be paid through savings from current energy and maintenance costs with no adverse impact to the General Fund (Ebrahimian 2009).

Future projected savings after the loan retirement will serve to address projected budgetary deficits in the SLMAF. The implementing agency was eager to take advantage of this financial and environmental opportunity as a way to improve the quality of life for Angelenos by demonstrating the best in municipal operating practices (CCI 2009).

Based on the developing technology and the changing nature of this market, the implementing agency is recommending that deployment be completed through City forces with salary costs enrolled into the

Duration (Payback Period)	07 Years
<b>Implementation/Procurement Model</b>	<b>Public Procurement-</b> By the public agencies on fixed fees for the installation and commissioning of the fixtures.
<b>Payment Model</b>	Loan provided by the City Utility (LADPW) of US\$40 million repaid through energy and maintenance savings.

loan. This will minimize the cost of the installation, change orders, and allow the agency to maintain the flexibility required for a successful project.

The program will need one Project Engineer, one Street Lighting Engineering Associate, one Street Lighting Electrician Supervisor, and four 2-person crews consisting of a Street Lighting Electrician and Assistant Electrician in the first year with two additional 2-person crews added in the second year of implementation. The labor costs for this program will be approximately US\$1 million the first year, US\$1.5 million the second, US\$1.6 million the third, US\$1.6 million the fourth, and US\$1.7 million the last year for a grand total of US\$7.4 million during the full five year installation plan. In addition to personnel the city will be requesting US\$150,000 in the Hiring Hall and US\$75,000 in the overtime accounts to compensate for annual vacancies, delays in hiring and other various factors that can contribute to delays in construction projects. This safety measure will ensure the implementation schedule of LED fixtures (CCI 2009). Table 8.3 provides brief summary of the project.

**Table 8.3: Project summary table for City of Los Angeles EE street lighting project**

Number of Streetlights Being Replaced	40,000
Technology	Converting old HPS cobra head fixtures to new LED fixtures, Implementing a remote monitoring system
Phase-In Period	5 years
Total Program Cost	US\$57 million
Payback	7 years
Energy and Maintenance Cost Savings (total):	US\$10 million /year
Energy Use Savings	68,640,000 kWh /year
CO <sub>2</sub> e Emissions Savings	40,500 tons / year
Financing	<ul style="list-style-type: none"> <li>• 7-year, US\$40million loan at a rate of 5.25% repaid through energy and maintenance savings</li> <li>• Loan provided by the city utility and city fund (LADPW)</li> <li>• Bureau of Street Lighting contributed US\$3.5 million straight from the Street Lighting Maintenance Assessment Funds.</li> <li>• LADWP will provide a rebate of US\$0.24 per kWh reduced by the project totaling US\$6.39 million</li> </ul>

Source: CCI2009.

#### **8.1.4 Australia, City of Sydney**

The City of Sydney was the first city in Australia to install 250 LED streetlights as part of an LED street lighting trial to help determine community acceptance and investigate aesthetics, operational issues, energy use, and capacity to meet the relevant lighting standards. By August 2011, 186 LED streetlights had been installed (Figure 8.2).



**Figure 8.2: Pilot Project Site**

Sydney has approximately 20,000 street and park lights, of which 12,000 are maintained by Energy Australia and 8,000 by the city council. For example in 2008/2009, the council spent AUS\$3.5 million (approximately US\$3.8 million) on electricity costs for the 20,000 lights and AUS\$2 million (approximately US\$2.2 million) on maintenance and upgrades of the 8,000 it maintains.

**Table 8.4: Summary of the Sydney’s Pilot Project**

<b>Location</b>	Sydney
<b>Number of installations</b>	250 LED Luminaires
<b>Approach</b>	A variety of commercial and residential locations were selected to monitor and collect of LED operating costs, lamp life, EE and green house gas savings
<b>Achievements</b>	Potential reduction in electricity and maintenance costs to City Council and Energy Australia (Utility)

A variety of installation sites have been selected under the LED street lighting trial including residential, commercial and locations which require significant lighting. Four companies have been invited to install LED street lighting in these locations.

The trial will enable the City of Sydney to monitor the quality and type of lighting, compliance with Australian Standards for public lighting, as well as on-going operating costs, EE and durability. This includes lamp failures, potential causes of lamp failure, and light output performance (for example, illuminance from luminaire at ground level, mains voltage supply, and current supply to luminaire). Upon conclusion of the trial, the data collected will be assessed in terms of operating costs, lamp life, EE, and greenhouse gas emissions (City of Sydney 2011).

### **8.1.5 Street Lighting in Latin America**

Latin America, specifically large countries like Brazil and Mexico are pilot ground for testing of installation of EE street lighting. Currently, however, things are in state of flux and transition, many cities are testing LEDs and other EE street lighting technologies, but still limited successful precedent of large-scale deployment of such technologies under varied conditions. The street lighting sector is complex, where decision are fragmented at the municipal level, because of which multiple energy prices, ownership

structure, institutional model, and technologies exists- and near future will continue to exist.

Some of the PPP projects in Peru, Columbia and Mexico have been executed in recent past in the region. Brazil is in process to start the PPP model EE street lighting project in some of its municipality. Latin America is yet to pick its PPP model of EE street lighting procurement and installation. Below are the examples that have just completed or in process to begin.

### **8.1.6 Street Lighting in Mexico**

The Federal Government established a national project for energy-efficient street lighting. The project provides technical and financial support to municipalities that wish to retrofit their street and outdoor lighting with more efficient lighting such as LED street lighting (IIEC 2011).

**Table 8.5: Project Summary for Othón Blanco Municipality, Mexico**

<b>Location</b>	Othón Blanco Municipality
<b>Number of installations</b>	25,507 LED streetlights
<b>Approach</b>	City street lighting outsourced to a lighting expert company through a 15 year concession
<b>Achievements</b>	Estimated 51% energy cost savings compared to current technologies

Source: IIEC 2011.

In 2010, the municipality of Othón Blanco announced a project to install 25,507 LED streetlights supplied by General Electric (GE) through a 15 year concession, making it one of the biggest LED street lighting projects in Latin America with estimated 51 percent energy cost savings compared to current technologies. According to GE, the resulting reduction in greenhouse gas emissions would be equivalent to removing about 40,000 vehicles from the road over a 10 year period (IIEC 2011).

### **8.1.7 Key Street Lighting Programs in South East Asia and East Asia Mainstreaming Energy Efficiency in Thai Municipalities Project**

The Government of Thailand received a grant from the Asian Development Bank (ADB) for the implementation of the Mainstreaming Energy Efficiency in Thai Municipalities Project, administered by the Provincial Electricity Authority (PEA). This includes a pilot project on LED street lighting in six municipalities; with a total of 100 LED roadway luminaires was to be installed by the end of July 2011. This project is direct procurement program initiated by the national government to increase the penetration of the EE street lighting (LEDs) technologies.

**Table 8.6: Project Summary of Major LED Street Lighting Projects in Thailand**

<b>Location</b>	Six municipalities
<b>Number of installations</b>	100 LED Luminaires
<b>Approach</b>	Supported by utility (PEA) and Asian Development Bank as demonstration project for mainstreaming EE in Thai municipalities
<b>Achievements</b>	Currently under implementation. If successful, it will be extended to further municipalities nationwide.

Source: IIEC 2011.

## **China**

In the People's Republic of China, the government setup an economy-wide demonstration project for LEDs through a domestic tender and each province and municipality can apply with their LED street

lighting projects. A total of 15 LED street lighting projects will be selected (each project must install at least 500,000 LED lights to be eligible) (IIEC 2011).

**Table 8.7: Summary of Major LED Street and Outdoor Lighting Projects in China**

<b>Location</b>	Nationwide
<b>Number of installations</b>	At least 7.5 million LED streetlights to be installed (target)
<b>Approach</b>	Government established nation-wide LED demonstration project and provides municipalities with funding support through tenders. Other cities, such as Xiamen City, Huizhou, and Guangdong province also developing their own street lighting projects.
<b>Achievements</b>	Supports national LED industry and ensures greater market uptake in a short period.

Source: IIEC 2011.

In addition, a number of cities and provinces established incentives, subsidies and plans for LED industry and LED street lighting project development. For example, in November 2009, the city of Huizhou in Guangdong Province joined the Cree LED City program, an international initiative aimed at promoting the deployment of energy-efficient LED lighting. Huizhou completed several LED streetlight trials and is in the process of deploying LED streetlights in the Zhongkai High-tech Industrial Zone. Xiamen City is also promoting LED street lighting projects including tunnel lighting with a total of 10,000 LED luminaires (IIEC 2011).

### **Republic of Korea**

In the Republic of Korea, the city councils are taking the lead in LED street and outdoor lighting and traffic lighting.

Balsan-dong or Balsan Street is an administrative division of Gangseo District (Gangseo-gu) in Seoul, South Korea. In this City Council, they decided to uptake the LED street lighting pilot project at one of the important street of the council and replace it with LED lights. This project is as

**Table 8.8: Summary for the Balsan, South Korea**

<b>Location</b>	Balsan or Balsan-dong, South Korea
<b>Replacement</b>	250 W to 55 W
<b>Approach</b>	City councils outsourced the work to the leading LED manufacturer and as per the contract also required to provide O&M.
<b>Achievements</b>	By replacing the old 250W lighting with the 55W GreenVision, Gangseo-gu was able to save up to 33.5MWh or 80% in energy consumption for Balsan Street. This translated to yearly savings of KRW3.6 million or US\$33,000 for Gangseo-gu. Furthermore, Gangseo-gu was able to reduce its carbon dioxide emission by 14.2 tons for Balsan Street alone.

Also, Gwangju Metropolitan City joined the LED City Initiative in 2009, an international program supporting the promotion and installation of LED lighting in cities across the world. At least 50 LED luminaires had been installed by August 2011. It is estimated that by replacing all street lighting with LED, it could save the city an estimated 234,000 kWh resulting in a reduction in carbon emissions estimated at 8.5 tons of CO<sub>2</sub> per year. **Gwangju City, which holds the country's leading photonics industry and technologies and LED Technical Assistance Center, opted to participate in this initiative to showcase Korean LED lighting products as well as energy and maintenance cost-benefits (CREE 2009).**

## 8.2 India Case Studies

### 8.2.1 Akola Municipal Corporation

One of the early successful EE street lighting projects in India was executed in Akola Municipal Corporation (AMC) in the state of Maharashtra. This project was signed on April 2007, to replace more than 11,500 streetlights (standard fluorescent, mercury vapor, sodium vapor) were replaced with efficient, T5 fluorescent tube lamps. This project utilized Energy Saving Performance Contract (ESPC) approach, to fund, implement and maintain the newly installed lamp and ESCO-Asia Electronics Limited (AEL) received portion of energy savings to recover its investment (ESMAP 2009).

The project resulted in annual energy savings of 2.1 million kWh (56%), representing reduced electric bills for the city totaling INR (Indian Rupee) 6.4 million (US\$133,000) per year. Since the total project cost was only about INR5.7 million (US\$120,000), the project payback period was less than 11 months. Because the project cost was entirely financed by AEL, acting as an Energy Service Company (ESCO), AMC did not have to make any upfront investment or assume performance risks under the project. Under the energy savings performance contract (ESPC), compensation to AEL was based on a shared **savings approach under which AMC paid AEL 95% of the energy bill savings over the contract's 6-year duration**. AEL was also paid an annual fixed fee for maintaining the lamps and fixtures (ESMAP 2009).

Keys features of the agreement between ESCO (that is, AEL) and municipality (that is, AMC) are as follows:

- AEL, in cooperation with AMC, developed and agreed on a measurement and verification (M&V) protocol based on Option A of the International Performance Measurement and Verification Protocol (IPMVP). A definition of the baseline energy consumption was developed by metering 10% of street-lighting circuits in Akola. Metered data was then used to estimate baseline energy consumption for street lighting throughout the city.
- AEL invested its own funds to replace the entire set of 11,518 street-lighting fittings (high-pressure sodium vapor lamps, mercury vapor lamps, and standard fluorescent tube lights) with energy-efficient, T5 fluorescent tube lamps, within a 3-month period.
- AEL and AMC staff monitored savings based on the metering of a 10% sample of lamps and used the data to estimate savings from all new lamps throughout the city.
- The M&V process is conducted each year in the first month of the financial year.
- Per the contract between AEL and AMC, AMC shares 95% of savings with AEL and retains 5% in electricity bills. In addition to shared savings payments, AEL also receives a share in maintenance saving.
- **The ESPC's duration is 6 years.**
- Under the ESPC, AEL must replace any failed lamps and maintain a minimum lux level.

The availability of locally manufactured energy-efficient T5 fluorescent tube lamps and existence of local ESCOs were also factors in the project's success. AEL is a major manufacturer of T5 lamps and showed its capacity and interest in taking on projects on a performance contracting basis. Further, AEL's ability to serve as an ESCO—that is, to mobilize financing, provide turn-key services, and guarantee project performance—also made the project succeed for all parties involved (ESMAP 2009).

Issues during contract negotiations included defining baseline energy consumption and the methodology used for verifying energy savings. A sampling approach using metered data from 10% of street lighting circuits was agreed and successfully implemented by AMC and AEL. Baseline development was an issue because prior to project initiation not all existing street lighting fixtures were working. To simplify the contract, AEL made additional investments to install old technology lamps in selected circuits where existing lamps were inoperative (ESMAP 2009).

### 8.2.2 Bhubaneswar and Jaipur—Performance-Based ESCO Street Lighting Project

IFC provided assistance to two municipal corporations (Bhubaneswar and Jaipur) by helping them design the program for EE street lighting project on the basis of the Shared Savings Performance contract model of ESCO. These two projects are viewed as a case study for municipality who are looking to adopt this ESCO model to design and implement their street lighting projects.

JMC is at the final stages of awarding the contract to the winner of the bidding process this year (that is, 2014). BMC signed the contract in October 2013 with the winner to start the project. These two project **will showcase the feasibility of the large street light PPP's projects in India and will encourage other ULBs to undertake similar initiative** (IFC 2013a).

BMC street lighting infrastructure was outdated and in poorly maintained. Entire system was operated manually and there was lot of leakage in the system because of this. Lack of inventory data and over 75% of the system lacks proper metering infrastructure. Bhubaneswar Municipal Corporation (BMC), the responsible authority, understood that it did not have the technical or financial capacity to modernize and manage its street lighting system. It considered entering into performance-based contracts with the private sector, whereby an Energy Service Company (ESCO) would upgrade the street lighting infrastructure and improve management through metering, remote monitoring, compliance with national lighting standards, and the use of inventory records. ESCO would recover its investment by claiming a share of energy savings realized. But the track record of ESCO contracts in other Indian cities was mixed: many failed because of poor preparation and risk allocation.

To avoid these pitfalls, BMC and its parent department, the Housing and Urban Development Department (H&UDD), requested the **IFC's assistance to design, structure, and manage the bid process for an ESCO-based street-lighting project in Bhubaneswar. The project marked the beginning of IFC's relationship with the Government of Odisha** (IFC 2013a).

Typical street lighting networks in Indian municipalities are operated with minimum investments or maintenance planning. Cities simply replace burned-out bulbs to minimize costs. ESCO Shared Savings model recommended by IFC, however, was designed so that efficient street lighting upgrades would be paid for and maintained by an ESCO, which in turn would receive payment through energy savings realized by BMC. In addition to energy consumption savings, IFC estimated BMC could also expect additional savings on the maintenance side and recommended that it share some of it as an operations and maintenance fee to be paid to ESCO. This created a powerful incentive for better efficiency.

The bid variable for the project was the energy savings committed by ESCO to BMC, subject to a 30 percent minimum. The winning ESCO and BMC would undertake a joint survey to establish the baseline energy consumption. BMC would use the data for monitoring and verification, including deviations from baseline, computations of adjustments, and determination of penalties. BMC also initiated payment security mechanisms including advance payment using ESCROW accounts and automatic approval of 75 % of operator invoices. This acted as strong incentives for ESCO to mitigate and hedge some of its financial risk through this mechanism (IFC 2013a). Please refer Table 8.9 for the project summary.

**Table 8.9: Summary of ESPC for Bhubaneswar Municipal Corporation**

Particular	Details
Model	Shared Saving BOOT Model
Project Coverage	Retrofitting and O&M of 19,873 Points across Bhubaneswar
ECMs	ESCO free to decide ECMs subject to meeting specified outputs and quality
Min. coverage	At least 70% of the verified points to be covered by ESCO ECMs

Project Duration	10 Years and to be revisited at 2.5 year mark to see if scope needs to be extended to any new areas that may have been added to the city.
Savings	Minimum/ Reserve value of Guaranteed Energy Savings at 30%
Bid Parameter	Guaranteed Energy Savings (%)
Sharing of Savings	90% to ESCO, 10% retained by BMC
Tariff Consideration	For the purpose of Sharing of Savings, Base Tariff @ Rs. 5.56/ kWh escalated at 2.5% per annum throughout out the project life
O&M Annuity Payment	Rs 300 per fixture per annum taken over by ESCO; escalated at 5.5% on yearly basis
Penalties and Liabilities	Loss to ESCO because of a difference between actual and quoted savings
Payment security	TRA or ESCROW Mechanism to enhance bankability; Letter of Comfort from HUD; 75% of invoice to be paid immediately upon submission, balance upon verification by Corporation

Source: IFC 2013a.

Similarly on this line JMC with assistance with IFC designed street lighting project and as is in final stage of awarding the project. Both projects are considered to be important models that could replicated by other ULBs.

Below are the key barriers faced by both the ULBs at the conceptualizing and design stage:

- Deficiency in existing infrastructure. Need for improvement
- Lack of data availability and reliability is also doubtful
- Lack of Energy Conservation Measures
- Lack of automation and Institutional MIS system
- Lack of institutionalized customer interface mechanism and customer service standards

### **8.2.3 Greater Vishakapatnam Municipal Corporation**

Government of Andhra Pradesh (GoAP) in partnership with Energy Efficiency Services Ltd (EESL) is currently working to retrofit/replace the existing in efficient street lighting fixture. GoAP in its study to overhaul its existing infrastructure decided to include EE as one of the major interventions. Under this initiative, GoAP has identified EESL for management of the EE programs and projects in the municipal sector. Annuity-based deemed savings model was adopted to design the Greater Vishakapatnam Municipal Corporation (GVMC) street lighting project by EESL. Similar model already is being successfully tested in Puducherry (explained in the next case study).

This project will replace approximately 90,000 street lighting with LED fixtures and total project cost will be approximately INR 57 crore (US\$10 million). Project summary is mentioned in Table 8.10.

**Table 8.10: Project Summary of GVMC**

Total Number of streetlights	90,000
Current estimated power consumption	7.7 MW
Estimated power consumption post project installations	3.8 MW
Estimated energy savings and % of savings	24million KWh and 62%
Equipment Cost (INR)	64 Cr

Power Factor post project	0.97
Annuity receivable over the contract period	18.5 Cr
Project duration	7 Years
EESL contribution towards project cost via Equity and Debt	30%:70%
Project IRR (%)	13.78%

The EESL methodology to implement EE street lighting project is being created out of need of having successful EE street lighting project, which could be used as case study to build capacity and understanding about Municipal EE projects. This would also, bring confidence amongst the investors about the capability of ULBs to design and implement these projects. This project also removes the barrier of M&V by having simple and effective methodology of determining baseline and energy savings.

Deemed savings model of implementation is important tool to increase awareness and penetration in the market till the time market is mature for ESCO-based EE projects. EESL employs its unique methodology, where only technology demonstration and validation of energy savings in a designated area required. The resources and the time for the validation is much less in this case—usually about 1 month as compared to 3-6 months in ESCO bases shared savings model (Ravi 2014).

This method involves multiplying the number of installed measures by an estimated (or deemed) savings per measure, which is derived from historical evaluations. Deemed savings approaches may be complemented by on-site inspections.

Key features of EESL model are mentioned below (EESL2014):

- **Payment not linked to energy bills:** As discussed earlier, payments are based on the initially demonstrated and agreed energy performance.
- **Savings demonstrations:** At the stage of DPR preparation, the energy performance is showcased by the sampling method.
- **Service level agreement:** To ensure technical performance of the project or system, SLA ensures high performance and product integrity during the agreed warranty period.
- **Payment security:** Bank guarantee to cover the capital cost or the state government guarantee.
- **Repayment of the investment:** On fixed annuity-based model paid by ULBs/MC monthly or quarterly.

#### **8.2.4 Puducherry Energy-Efficient Street Lighting Initiatives**

Puducherry government and EESL initiated EE street lighting program in their Union Territory (U.T). This program was designed and developed on the guidelines of EESL annuity-based deemed saving model as discussed earlier part of this report (Project highlight in Table 8.9). Under this project Government of Puducherry has taken steps to undertake up gradation of its entire conventional fixtures with LED fixture.

**Table 8.11: Highlights of EE Street Lighting Project in Puducherry, India**

Total Number of streetlights	46,646
FTL 40W	38,041
HPSV 250W	8,605
Current estimated power consumption	13.77 MU
Estimated power consumption post project installations	6.17 MU
Estimated energy savings and % of savings	7.6 MU and 55 %
Equipment Cost (INR)	29.08 Cr
Maintenance Cost during contract period	7.41 Cr
Annuity receivable over the contract period	9.26 Cr

Project duration	7 Years
EESL contribution towards project cost via Equity and Debt	30 % : 70 %
Project IRR (%)	13.78 %

Source: Ravi 2014.

## 8.3 Key Takeaways from Case Examples

Street lighting services present immense opportunities for energy savings because of their scale and visibility in the public domain. Public Private Partnership– (PPP-) based models, such as energy savings performance contracting (ESPC) models—offered by energy service companies (ESCOs) or other energy service providers—have become common tools to enhance the sustainable use of energy through EE measures and have been used by municipalities and cities to implement street lighting programs in many parts of the world. The performance contracting structure has proved successful with municipal authorities in many developed markets such as France, Germany, UK and USA, as well as emerging economies such as Chile and Mexico. But scalability of such model is yet to be achieved.

Generally, through various interactions with different stakeholders, financing institutions and ESCOs still believe that the market is small and not very lucrative for investors to make investments. The small projects do not ensure adequate returns on their investments. Also, poor infrastructure and unrealistic expectations were seen as barriers by the investors and ESCOs during the interactions at Global EE street lighting conference held at New Delhi this year. Since this sector is yet to overcome many barriers, successful projects are required to be showcased to replicate these models elsewhere in the ULBs. Also, the one-solution–fits-all theory will not be successful, since every municipality has its own challenges and issues.

### **Lowest common denominator for EE Street lighting projects are:**

- There is a requirement to have concrete planning and design of energy efficiency programs after aligning with all the stakeholders;
- There is a need to investment in awareness creation, capacity building and handholding of city Governments;
- Government should be committed to reform of municipal street lighting management & practices;
- Standardization of procurement methodologies, baseline setting methods, M&V protocols, and so forth;
- There is a need to introduce simplified and stable Standard Offer Programs (SOPs) for municipalities to design and implement street lighting projects;
- Capacity building at all levels of ULBs and municipal corporations.

Additional EE street lighting case studies are highlighted in the **Appendix G** of this manual.

# **APPENDIXES**

## Appendix A: Outline for Contract for IGA

**COVER PAGE of the Contract with ULB Name and details of contact personnel**

### **PART 1 FORM OF CONTRACT**

#### **Lump Sum Remuneration**

This CONTRACT (hereinafter called the "Contract") is made the \_\_\_\_\_ day of the month of \_\_\_\_\_, 20\_\_\_\_, between, on the one hand, M/s. MUNICIPALITY and having its registered office at \_\_\_\_\_, herein after called the "Municipality," (which expression shall, unless excluded by or repugnant to subject or context thereof, include its successors or assigns), and on the other hand, M/s. \_\_\_\_\_, a company registered under Companies act 1956, having its registered office at \_\_\_\_\_, hereinafter called the "Consultants"<sup>9</sup> (which expression shall, unless excluded by or repugnant to subject or context thereof, include its successors and assigns).

#### WHEREAS

- a. the Municipality has requested the Consultants to provide certain consulting services as defined in the General Conditions of Contract attached to this Contract (hereinafter called the "Services");
- b. the Consultants, having represented to the Municipality that they have the required professional skills, and personnel and technical resources, have agreed to provide the Services on the terms and conditions set forth in this Contract; and

NOW THEREFORE the parties hereto hereby agree as follows:

1. The following documents attached hereto shall be deemed to form an integral part of this Contract:
  - (a) The General Conditions of Contract (hereinafter called "GC");
  - (b) The Special Conditions of Contract (hereinafter called "SC");
  - (c) The following Appendices:

Appendix A: Description of the Services: \_\_\_\_\_

Appendix B: Reporting Requirements: \_\_\_\_\_

Appendix C: Key Personnel \_\_\_\_\_

Appendix D: Services and Facilities \_\_\_\_\_

Provided by Municipality

Appendix E: Breakdown of Contract Price \_\_\_\_\_

<sup>9</sup>If the Consultants consist of more than one entity, the above should be partially amended to read as follows:

"...(hereinafter called the "Municipality") and, on the other hand, a joint venture consisting of the following entities, each of which will be jointly and severally liable to the Municipality for all the Consultants' obligations under this Contract, namely, \_\_\_\_\_ and \_\_\_\_\_. (hereinafter called the "Consultants.")".

2. The mutual rights and obligations of the Municipality and the Consultants shall be as set forth in the Contract; in particular:
  - a. The Consultants shall carry out the Services in accordance with the provisions of the Contract; and
  - b. The Municipality shall make payments to the Consultants in accordance with the provisions of the Contract.

**IN WITNESS WHEREOF, the Parties hereto have caused this Contract to be signed in their respective names as of the day and year first above written.**

FOR AND ON BEHALF OF

[Name of the Municipality]

**By**  
(Authorized Representative)

**FOR AND ON BEHALF OF**  
[Name of the Consultant(s)]

**By**  
(Authorized Representative)

FOR AND ON BEHALF OF EACH OF THE

**MEMBERS OF THE CONSULTANTS**  
[Name of the Member]

**By**  
(Authorized Representative)

[Name of the Member]

**By**  
(Authorized Representative)

## **PART II GENERAL CONDITIONS OF CONTRACT**

### **1. General Provisions**

- 1.1. Definitions*
- 1.2. Relation between the Parties.*
- 1.3. Law Governing Contract*
- 1.4. Language*
- 1.5. Headings*
- 1.6. Notices*
- 1.7. Location*
- 1.8. Authority of Member in Charge*
- 1.9. Authorized Representatives*
- 1.10. Taxes and Duties*

### **2. Commencement, Completion, Modification and Termination of Contract**

- 2.1. Effectiveness of Contract*
- 2.2. Termination of Contract for Failure to Become Effective*
- 2.3. Commencement of Services*
- 2.4. Expiration of Contract*
- 2.5. Entire Agreement*
- 2.6. Modification*
- 2.7. Force Majeure*
  - 2.7.1 Definition**
  - 2.7.2 No Breach of Contract**
  - 2.7.3 Measures to be taken**
  - 2.7.4 Extension of Time**
  - 2.7.5 Payments**
  - 2.7.5 Consultation**
- 2.8. Suspension*
- 2.9. Termination*
  - 2.9.1 By the Municipality**
  - 2.9.2 By the Consultants**
  - 2.9.3 Cessation of Rights and Obligations**
  - 2.9.4 Cessation of Services**
  - 2.9.5 Payment upon Termination**
  - 2.9.6 Disputes about Events of Termination**

### **3 Obligations of the Consultants**

#### *3.1 General*

- 3.1.1 Standard of Performance**
- 3.1.2 Law Governing Services**

#### *3.2 Conflict of Interests*

- 3.2.1 Consultants Not to Benefit from Commissions, Discounts**
- 3.2.2 Procurement Rules of Funding Agencies**
- 3.2.3 Consultants and Affiliates not to engage in Certain Activities**
- 3.2.4 Prohibition of Conflicting Activities**

### *3.3 Confidentiality*

### *3.4 Liability of the Consultants*

### *3.5 Insurance to be Taken Out by the Consultants*

### *3.6 Accounting, Inspection and Auditing*

### *3.7 Consultants' Actions Requiring Municipality's Prior Approval*

### *3.8 Reporting Obligations*

### *3.9 Documents Prepared by the Consultants to Be the Property of the Municipality*

## **4 Consultants' Personnel and Subconsultants**

### *4.1 General*

### *4.2 Description of Personnel*

### *4.3 Approval of Personnel*

### *4.4 Removal and/or Replacement of Personnel*

### *4.5 Resident Project Manager*

## **5 Obligations of the Municipality**

### *5.1 Assistance and Exemptions*

### *5.2 Changes in the Applicable Law*

### *5.3 Services, Facilities and Property of the Municipality*

### *5.4 Payment*

## **6 Payments to the Consultants**

### *6.1 Lump Sum Remuneration*

### *6.2 Price*

### *6.3 Payment for Additional Services*

### *6.4 Terms and Conditions of Payment*

## **7 Fairness and Good Faith**

### *7.1 Good Faith*

### *7.2 Operation of the Contract*

## **8. Settlement of Disputes**

### *8.1 Amicable Settlement*

### *8.2 Dispute Settlement*

## **SPECIAL CONDITIONS OF CONTRACT**

<Include any special conditions needed into the contract as per the Number of the clause>

## **APPENDICES FOR CONTRACT**

### **Appendix A: Description of the Services**

*[Give detailed descriptions of the Services to be provided including dates for completion of various tasks, place of performance for different tasks, and specific tasks to be approved by Municipality.]*

**Appendix B: Reporting Requirements**

*[List format, frequency, contents of reports, and number of copies; persons to receive them; and dates of submission. If no reports are to be submitted, state here "Not applicable."]*

**Appendix C: Key Personnel and Sub-consultants**

- *Titles [and names, if already available], detailed job descriptions and minimum qualifications. Experience of Personnel to be assigned to work in India, and staff-months for each*
- *Key local Personnel*
- *Key foreign Personnel to be assigned to work outside India*
- *List of approved Sub-consultants [if already available];*

**Appendix D: Services and Facilities Provided by Municipality**

*To be listed by the Municipality*

**Appendix E: Breakdown of Contract Price in Local Currency**

*List hereunder cost estimate in local currency:*

- *Monthly rates for local Personnel (Key Personnel and other Personnel)*
- *Reimbursable expenditures*

## **Appendix B: Outline of Template for EOI for Undertaking an IGA**

**COVER PAGE of the EOI with ULB Name, Logo, Project Title and Contact Person Details**

## 1.1 Preamble

As part of energy efficiency improvement program, MUNICIPALITY is seeking "Expressions of Interest (EOI)" from "Energy Service Companies" (ESCO)/ Consultants to conduct Investment Grade Audit study and implementation for street lighting.

This document covers the specific information to be provided by the interested parties on the qualifying requirement to perform such services.

## 1.2 Background

*<Include information on the background of the Municipal in one paragraph Please provide Basic System Details, including average annual energy consumption, and population.>*

**1.3 Brief scope of work of ESCO/Consultant contract includes the following:**

To conduct the Investment Grade Energy Audit (IGA) and implementation for existing Street Lighting systems in the MUNICIPALITY:

- To identify, design and implement Energy Saving Projects (ESPs) in the street lighting systems and to prepare an Investment Grade Audit Report (Report)
- To propose detailed projections of energy and cost savings to be obtained at the facility(s) as a result of the installation/implementation of the recommended ESPs and prioritize strategy

(immediate and long-term actions) for improving energy savings and efficiency enhancement.

- To establish energy consumption baseline:
  - Present input/output
  - Boundary of limits
  - Parameters variations
  - Models for adjustments and impacts
  - Specific energy figures (new/old)
- To conduct financial and technical risk analysis
- To develop project Measurement and Verification plan

#### *1.4 Submission of EOI and Eligibility Criteria*

The engagement of ESCO/Consultant will be based on the **Quality-and-Cost-Based Selection (QCBS)** linked to performance. Interested firm(s) should method of appointment with payment submit the information requested in **Annex 1**.

#### 1.5 Future Process

Based on an evaluation of the EOI received, the interested parties evaluated as “qualified” will be short-listed to participate in the subsequent selection process. Thus, following the evaluation of EOIs, the MUNICIPALITY intends to issue a “Request for Proposal” inviting proposals to be submitted for the “services” in accordance with the RFP. Details regarding the evaluation methodology are provided in **Annex 2**.

#### *Enquiries*

All enquiries in relation to this “Expression of Interest” must be directed to:

#### *Name and Contact details*

### **ANNEX 1**

#### INFORMATION SHEET

Applicant’s details

Company name . . . . .

Address . . . . .

Name of company’s representative . . . . .

Position . . . . .

Address for communication . . . . .

Phone . . . . .

*Facsimile* . . . . .

Email . . . . .

Year of establishment of firm . . . . .

Year of commencement of Energy Auditing /ESCO activities . . . . .

Experience and capabilities

#### **1. General**

- a) Structure and organization of the firm and infrastructure available, accreditation with the Bureau for Energy Efficiency (BEE), list and number of portable measuring instruments supported by calibration certificates;
- b) Information regarding technical experts/personnel available at the firm including BEE Certified Energy Auditors with copies of the BEE certificates.

## 2. Technical Capability

- a) Number of detailed (comprehensive) energy audit studies completed by ESCO/Consultant in the past five years. Please give sector details and attach a list of clients. Also attach a copy of one detailed energy audit report (preferably for street lighting and public undertaking infrastructure) for a project listed under “A” above, including method used to compute energy baselines.
- b) List of similar assignments completed or undertaken (such as street lighting and municipal infrastructure experience) so far, including name of client, location, contracted demand of the facility, contract value, duration of services, and description of services provided. (with appropriate supporting testimonials and references for each assignment listed).

- c) Details of available energy metering instruments and other audit equipment, such as electrical, light, and water flow measuring instruments.

## 3. Available Staff

- a) List key personnel in your firm that you are intending to use on any potential projects. Information should include:
  - Experience in energy management and energy efficiency services,
  - Education,
  - BEE certified energy auditor(s) /manager(s)

## 4. Financial Capability

- a) Financial capability—3-year balance sheet and Profit and Loss Account of the firm
- b) Any other relevant information deemed necessary to enable assessment of the firm’s capability.

## 5. Certification

- Number of years with this firm, and

I certify that I am authorized to represent the ESCO/Consultant named below and that all statements contained in this EOI are true and correct.

Dated at \_\_\_\_\_ this \_\_\_\_ day of \_\_\_\_\_ 20\_\_.

Name of ESCO/Consultant: \_\_\_\_\_

By: \_\_\_\_\_

Title/Position: \_\_\_\_\_



## ANNEX 2

## EVALUATION SCORING SHEET

<b>PROJECT NAME:</b>									
<b>FORM 1: EVALUATION SHEET FOR SHORTLISTING OF CONSULTANTS BASED ON EOI</b>									
Evaluation Criteria	Weight	Firm-1		Firm-2		Firm 3		Firm-4	
		Rating	Score	Rating	Score	Rating	Score	Rating	Score
Accreditation/Certification by BEE and/or PCRA	10								
No. of Certified Energy Auditors with the firm	10								
Performance contracting experience	10								
Measuring instruments available	10								
Annual turnover during the past 3 years	10								
Similar assignments experience	25								
Experience in energy auditing	25								
<b>Total</b>	<b>100</b>								
<b>Score</b>	<b>Weight X Rating/100</b>								
<b>Minimum qualifying score</b>	<b>75</b>								

<b>FORM 2: RATINGS<sup>2</sup></b>	
Temporary accreditation by BEE	Accredited-100% Non-Accredited-0%
No. of Certified Energy Auditors with the firm	More than 5-100% <sup>3</sup> 5 Auditors-90% 4 Auditors-80% 3 Auditors-70% 2 Auditors-60% 1 Auditor-50%; No Auditors-0%
Performance contracts	3 and More than 3 projects-100% 2 projects- 80% 1 project- 60%
Measuring Instruments available	2 sets and above-100% 1 Set-80%
Annual Turnover during the past 3 years	More than 100 Lacs-100% 80-100 Lakhs- 90% 70-80 Lacs-80% 60-70 Lacs-70% 50-60 Lacs-60% 40-50 Lacs-50% 30-40 Lacs-40%

	20-30 Lacs-30% Less than 20 Lacs-20%
Similar assignments conducted	5 Jobs and above-100% 4 Jobs-90% 3 Jobs-80% 2 Jobs-70% 1 Job-60%
Experience in energy auditing (Contract value over Rs. 8 Lakhs)	More than 8 Jobs-100% 6-8 Jobs-80% 4-6 Jobs-60%; Less than 4 Jobs-0%

# Appendix C1: Outline of Template for RFP for Undertaking An IGA

## COVER PAGE with the ULB name, logo, project title and contact details

### Letter of Invitation

*<This letter from the ULB invites the shortlisted applicants from the EOI stage to submit a full scale proposal for undertaking a detailed IGA and implement EE project. This letter is sent to only select applicants and the list is included in the letter. The letter also specifies the components of this call, in terms of documents included in the RFP to facilitate the reader.>*

### Information to Consultants and Data Sheet

*<This section of the RFP is divided in several subsections, which basically takes the applicant through the application process and specifies various requirements, qualifications and formats for the applicant to be selected for the task. It defines the formats and requirements of the technical and financial proposals. A brief description of the subsections under this section of the RFP is indicated below.>*

#### 2.1. Introduction

*<This subsection of the RFP should focus on providing instructions to the prospective applicants on the objectives of the project, details on project phases, and legalities associated with the contract. It is basically an overview of the contents of the RFP.>*

#### 2.2. Clarification and Amendment of RFP Documents

*< This subsection mentions the process and methods of communications between the applicant and the municipality for any clarifications related to the RFP documents. Municipality in this section also specifies the method of communications for any amendments it decides to make to the RFP documents.>*

#### 2.3 Preparation of Proposal

*<This subsection gives instructions for preparation of the technical and financial proposals by the prospective applicants. Instructions for the technical proposal may include information on whether the consultants could submit application individually or consortium, the type of professional staff to be included, any comments or suggestion on the TOR, methodology for undertaking the IGA, details on proposed team strength, staff characteristics, and formats of the staff CVs. The instructions for the financial proposal method of presenting the financial bid, in terms of staff rates, staff months, commissions and gratuities, and validity of the financial proposal, for example, should be included in the bid document.*

#### 2.4. Submission, Receipt, and Opening of Proposals

*<this subsection highlights the process of submission, receipt and opening of the proposals in a way to convey to the applicants the way the proposal should be packaged (sealed envelopes and text on the envelopes) and what would be the immediate next step as soon as the proposal is received by the municipality.>*

#### 2.5. Proposal Evaluation

*<This subsection of the RFP focuses on providing information on the evaluation of the proposal by the Municipality. This generally includes three further sections, one is a General section which highlights any generic information, second section is on method of evaluation of the technical proposal and third, on financial proposal and ranking.>*

##### 2.5.1. General

##### 2.5.2. Evaluation of Technical Proposals.

##### 2.5.3. Public Opening and Evaluation of Financial Proposals; Ranking

## 2.6. Negotiations

<This section highlights the way the negotiations will be undertaken on the technical and financial proposals of the selected applicant.>

## 2.7. Award of Contract

<Following the stage of negotiations, the Municipality will begin the process of awarding the contract, and the way it will happen is mentioned in this subsection of the RFP.>

## 2.8. Confidentiality

<This section specifies the confidentiality clauses associated with sharing the information on the technical and financial proposals.>

## 2.9. Cancellation of RFP

<The cancellation rights of the Municipality are mentioned here.>

## 2.10. Data Sheet: Investment Grade Energy Audit and Implementation in Municipalities/ Municipal Corporations in State

This section gives a tabulated version of the all the data related to the RFP. This includes information on:

- Name of the Municipality
- Method of Selection
- Type of Proposal Required
- Name of the Assignment
- Objectives
- Is the Assignment Phased?
- Will a pre-proposal conference be held?
- The names, address, telephones numbers of the Municipality official
- Does the Municipality envisage the need for continuity for downstream work?
- The clauses on fraud and corruption in the contract
- Clarifications may be requested up to \_\_\_\_\_
- The address for requesting clarifications
- Language of the proposals
- Can shortlisted firm/entity associate with other shortlisted firms?
- The estimated number of key professional staff days required for the assignment
- The positions specified
- The minimum required experience of proposed key professional staff
- Taxes
- Currency
- Validity
- No of copies of technical and financial proposals
- Proposal submission address
- The information on the outer envelope should also include \_\_\_\_\_
- Date of submission of the proposal

This section also specifies the points that are given to each evaluation criteria. The evaluation criteria themselves could include the following:

### **Specific experience of the consultants firm related to the Assignment**

- Experience in similar assignment to investment grade energy studies in municipalities/ municipal corporations
- Experience in other relevant assignments (energy audits)

### **Qualifications and competence of the key staff for the Assignment**

- Team leader
- Project Manager
- Electrical Engineer
- Mechanical Engineer

### **Performance contracting experience:**

- a. Stated capability to carry out a performance contract
  - Mechanical
  - Electrical
- b. Staff experience in implementing a performance contract

### **Experience in validation and PMV**

**Ability to provide guarantees for energy savings and for performance of installed systems****Annual turnover and financial parameters and experience in financing providing third party**

*2.11 The Breakdown of points for evaluation of the key staff qualifications and competence:*

*2.12. Data to be provided by the Municipality to the Consultants*

<b>Data/Information required to be provided by the municipality</b>
Name of the municipality
Contact person, address and contact details including mobile number
Location (State and District)
Approximate distance in KM from the state capital
Grade/Class of the municipality
Population as per recent census (Mention the year)
Area of the municipality in sq. km
Area map of the municipality is available- Yes/No
If available, whether it is to scale or not to scale

<b>Street Lighting and Electrical distribution system</b>
Number of substations in the municipality
Total number of HT feeders from the substations
Electricity consumption for street lighting systems- Monthly average in kWh
<b>Inventory Details</b>
Number of Transformers for the purpose of street lighting in the capacity range of
Less than 25 kVA
26 kVA to 50 kVA
51 kVA to 100 kVA
101 kVA to 200 kVA
More than 201 kVA

**Please inform whether the following information are available—Yes or No**

Connected load of the individual transformers for street lighting, handling systems separately

Number of feeders in individual transformers for the purpose of street lighting

Number of light posts in each of the feeders

Type and wattage details of the lights in the individual light posts

Length, conductor size and conductor material of each feeder from the individual transformers

Electrical single line diagram

### 3. Technical Proposal Formats

*3.1. Form 3A: Technical Proposal Submission Form*

*3.2. Form 3B: Firm's References*

#### Relevant Services Carried Out in the Last Five Years that Best Illustrate Qualifications

Using the format below, provide information on each reference assignment for which your firm, either individually as a corporate entity or as one of the major companies within an association, was legally contracted. The total number of references provided shall not exceed 10 (Ten)

#### *3.3. Form 3C: Comments and Suggestions on the Terms of Reference, Data, Services and Facilities to be provided by the Municipality*

On the Terms of Reference:

On the data, services, and facilities to be provided by the MUNICIPALITY

.

Consulting Firm's Name: \_\_\_\_\_

#### *3.4. Form 3D: Description of the Methodology and Work Plan to Perform the Assignment*

The Municipality has to design this form in accordance with the needs of the particular project. Refer to the guidelines on the steps involved in investment grade audit for Municipal EE projects; and guideline on technical scopes of work for Municipal EE for the details that can be included in this form.

#### *3.5. Form 3E: Team Composition and Task Assignments for technical/managerial and support staff*

3.6. Form 3F: Format of CV of Proposed Professional Staff

3.7. Form 3G: Time Schedule for Professional Personnel

3.8. Form 3H: Activity (Work) Schedule

### 4. Financial Proposal Formats

4.1. Form 4A: Financial Proposal Submission Form

#### *4.2. Form 4B: Summary of Costs*

4.3. Form 4C: Breakdown of Remuneration

#### *4.4. Form 4d: Breakdown of Reimbursable*

## **Appendix C2: RFP for the ESPC Model 2.3, the Annuity-based Deemed Savings Model**

For Supply, Installation (retrofit), Testing,  
Commissioning, warranty, Maintenance of LED  
Streetlights and Related Works for

(Logo and Name of Municipal Corporation along with Project Name)

**Request for Proposal for**  
**“DPR Preparation/ Data Revalidation, Supply, Installation, Testing,**  
**Commissioning and Maintenance of LED Street Light Fixtures and Related**  
**Work at .....”**

“Bid Package No: .....”

**Prepared by**

**Name of Municipal Corporation**

**Address**

## **TECHNICAL and SPECIAL CONDITIONS OF THE CONTRACT**

**Name of Work:** SUPPLY, INSTALLATION (RETROFIT), TESTING, COMMISSIONING, WARRANTY, MAINTENANCE OF LED STREETLIGHTS AND RELATED WORKS AT \_\_\_\_\_  
(Name of the Municipal Corporation and Area.)

**NIT/Bid Document No.:** \_\_\_\_\_

**Dated:** \_\_\_\_\_

### **BIDS ARE TO BE SUBMITTED AS FOLLOWS:**

**ENVELOPE I** should contain following:

- a. Bid Security fees/Earnest Money Deposit as Attachment 2 by Banker's Cheque/ Demand Draft drawn in favour of "\_\_\_\_\_ (Name of the Client)" or in the form of Bank Guarantee as per prescribed format in section 4.
- b. Letter of the bidder submitting the bid in the form as stipulated in the bid document i.e., as per Bid Form as attachment 1 of section - 4, Forms & Procedure.
- c. Power of attorney to sign the bid as attachment 3 of section 4, Forms & Procedure. Bidders to use their own format.
- d. Certificate regarding acceptance of important terms and conditions as per ITB clause 4.6 as attachment 4. Format enclosed in section 4.
- e. Form of acceptance of "\_\_\_\_\_ (Name of the Client)" fraud prevention policy as per attachment 8 of section 4, Forms & Procedure.

**ENVELOPE II** should contain the following:

- a. Deviation statement as per attachment 5 of section - 4, Forms & Procedure.
- b. Techno-commercial bid as indicated in bid document. Documentary evidence regarding bidder's qualifications to perform the contract as required in qualifying Requirement.
- c. Signed copy of RFP and subsequent amendments, if any.
- d. Stamped Certificate & Dialux report for compliance of IS 1944 uniformity & minimum average lux level as per tender & IS 16105 (LM 79) and all other specification which is mentioned in the tender document from NABL accredited laboratory should be submitted along with the tender document. In absence of the above NABL certificate / incomplete bid will be rejected.
- e. The attached forms (Annexure A & C) regarding indexing of technical parameter & certificates must be filled in along with page number. Unorganized/Unlabeled Bids may not be evaluated.
- f. The decision of the tender committee in all respect shall be binding on the bidders.

**ENVELOPE III** should contain Price Bid, to be submitted in 3<sup>rd</sup> inner sealed envelope, shall comprise of:

- a. Price Bid in the format prescribed in the tender document

Initially, **Envelope I** containing documents as stated above will be opened. **Envelope II** will be opened on the same day of only those bidders who have submitted EMD and requisite documents in Envelope I.

**Envelope III (Price Bid)** shall be opened subsequently subject to acceptance of Techno-Commercial Bid. Opening date will be intimated to all those bidders, who are found technically and commercially acceptable to \_\_\_\_\_ (Name of the client).

Price-Bid of the technically disqualified bidders will be returned in unopened condition to the respective bidders.

On behalf of \_\_\_\_\_

Name and Designation of Authority

## INTRODUCTION

### Objectives

- To facilitate preparation of EE projects for Demand Side Measures, including municipal functions, agriculture, public building, and lighting.
- To implement schemes, programs and policies of central and state governments or its agencies.
- Partner with private ESCOs and other companies to promote EE.
- To provide consultancy services in the field of EE, CDM projects, and other related areas.
- To identify and impart training to build the capacity of stakeholders.

## PROJECT OBJECTIVE AND BACKGROUND

### 3. SCOPE OF WORK—LED Lights

*(Write in Brief about the scope of the work in this section)*

#### a) Name of the Municipality and area

The scope of work essentially consists of two parts:-

1. Installation of new LED fixture (including LED, Driver and fixture):
  - i. Bidder has to supply and install the LED systems within 18 days of the Date of Award. **Bidders are requested to bid *only* if they will be able to supply, test and commission the lights on site by (date of the submission)**
  - ii. The specifications of the luminaries shall be as per given in the Technical Specifications attached.
  - iii. Energy Saving Demonstration is in the scope of the bidder.
  - iv. To arrive upon the energy savings, separate energy meter will be installed by the successful bidder before and after the LED installation as directed by \_\_\_\_\_ (Name of the Municipality) representatives for the purpose of energy savings demonstration on representative basis. Meter is to be a smart energy meter or one that shows the value of volt, current, power factor, wattage, and working hour. It should record the KWH and hours for the period. If it records the peak value of Volt, current and PF, the same will be given preference.
  - v. All the machineries and instruments required for the implementation of the project is to be arranged by bidder and their expense is also to be borne by the same, (Name of the ESCO) will only provide the coordination.
2. Repair and Maintenance of LED fixture (including LED, Driver and fixture):

#### Scope of work under Warranty

- The LED luminaries, mechanical structures, electrical works including overall workmanship of the LED Lighting system must be warranted against any manufacturing defect as per the period specified in the RFP.
- During the warranty following maintenance will required to be carried out by the bidder:
  - Repairing / replacement of all defective components and subcomponents of the system as per the requirement to ensure proper operation of the system.
  - The scope of work includes repairing/replacement of part(s) /system to make the system functional within warranty period whenever a complaint is lodged by the user at site. The breakdown shall be corrected within a period not exceeding 3 days.
  - It is mandatory for the bidder to submit a Weekly performance / maintenance report for each system.

- Bidder shall give a comprehensive, on-site warranty of 2 years from the date of installation and commissioning for the newly installed LED fixtures and system on-site. Further, the supplier is responsible to provide additional warranty for 3 years after the expiry of on-site warranty of 2 years. Charges for the additional warranty period must be quoted in rupees in the Commercial Offer/ Price-Bid. During the total comprehensive, on-site warranty period of 5 years, the supplier is expected to maintain the LED fixtures and system and repair / replace all defective components, major or minor and may use for this purpose spares or consumables at no additional charge other than the additional warranty charges.
- Subsequently, Bidders have to quote separately for the On-site AMC services for 3 years (if applicable) after the expiry of the 5 year warranty period.
- The bidder shall ensure satisfactory performance of the fixture for a period of five years. Any repairs shall be carried out and the repaired fixture delivered and installed on-site.
- The quality of spare or new fixture should be as per earlier installed fixture or system for replacement during warranty or On-site AMC. **(AMC charges can be quoted by Bidder separately but the same will not be considered as part of Price Bid for placing the L1,L2.... Positions.)**

The **Comprehensive Maintenance** (within total warranty period of 5 years) shall be executed by the firm themselves or the authorized dealer/ service center of the firm in the concerned district. Necessary maintenance spares for trouble free operation shall also be supplied with the system including the warranty period.

### 3. Parameters of Design of LED Streetlights for \_\_\_\_\_ (Name of the Municipality and Area):

As per (Indicative) Table—South and West Zone attached

S. No.	Description	Type Preferred
1.	Category of Road	A-1
2.	Pole Configuration	
3.	Lamp height for road surface	
4.	Pole span	
5.	Road width	
6.	Median	
7.	Lamp wattage	The bidder must design the lamp wattage based on the existing luminaire wattage (250W/ 150W), given road and pole detail.
8.	Arm Length	
9.	Arm angle	
10.	Type of Road	

Note: Regarding lamp wattage point 6 on the above table:

- a. The bidder must design the lamp wattage based on the given road and pole details, which complies with all the tests and standards mentioned in the tender documents, such as uniformity as per IS 1944, and average lux level on the road as per nine-point method specified in the NLC for A-1 category road. The road category is A-1 and the Pole Height chosen by \_\_\_\_\_ (Name of the Municipality) is as per A-1 category road.

- b. The lamp should comply standard / maintained the average lux level on the road after 5 years of operation.
- c. Lux level to be maintained at **A-1(30 LUX Minimum)** during the entire contract period.
- d. \_\_\_\_\_ (Name of ESCO) will give weightage to bidder who will design the lowest wattage of lamp for the above condition but at the same time, offering to maintain the Lux Level as per category of road. Appropriate notional loading of energy consumption is done on the price bid to give preference to LED Lights which have lower wattage but with higher Lumen Output, Lux Level and Uniformity Ratio.

### 3.1 Technical Specifications of Luminaries:

*Definition:*

*Luminaries:* Lighting EE is a function of both the light source (the light “bulb” or lamp) and the fixture, including necessary controls, power supplies, other electronics, and optical elements. A luminaire is defined as a complete unit consisting of a lamp, together with the parts designed to distribute the light, to position and protect the lamp, and to connect the lamp to the power supply. Components that make up a luminaire include the reflector, the refractor, and the housing. These are important to ensure luminaire efficiency and cut-off and glare control, to guarantee the right level of lighting while avoiding light pollution. The specification for selection of street lighting luminaire has been provided in IS 10322 Part I to Part V.

Luminaire are classified into three categories according to the degree of glare (BIS 1981) (their application is indicated in table below):

*Cut-off luminaire:* A luminaire whose light distribution is characterized by rapid reduction of luminous intensity in the region between about 80° and the horizontal. The direction of maximum intensity may vary but should be below 65°. The principal advantage of the cut-off system is the reduction of glare.

*Semi-cut-off luminaire:* A luminaire whose light distribution is characterized by a less severe reduction in the intensity in the region of 80° to 90°. The direction of maximum intensity may vary but should be below 75°. The principal advantage of the semi-cut-off system is a greater flexibility in siting.

#### Classification of Roads (BIS 1944) Group Description

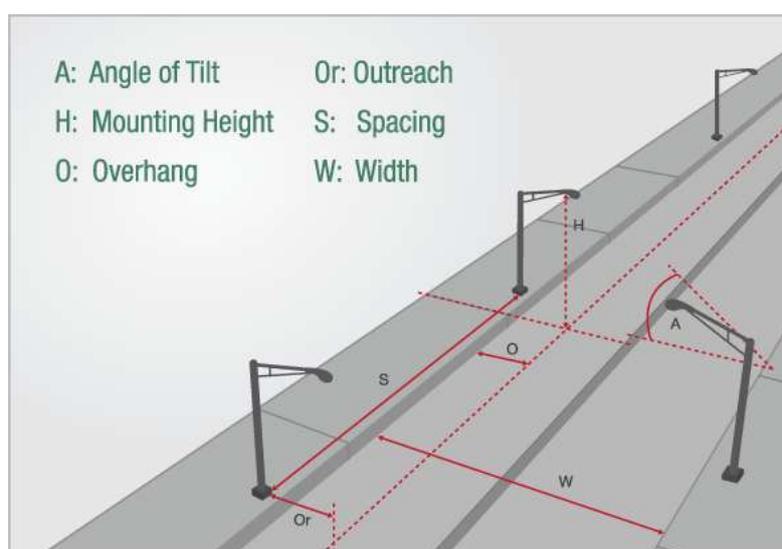
Group	Description
A1	For very important routes with rapid and dense traffic where the only considerations are the safety and speed of the traffic and the comfort of drivers
A2	For main roads with considerable mixed traffic like main city streets, arterial roads, and thoroughfares
B1	For secondary roads with considerable traffic such as local traffic routes, and shopping streets
B2	For secondary roads with light traffic

#### Mounting Height of Luminaries (BIS 1944)

Group	Recommended Mounting Height
A1	9 to 10 meters
B1	7.5 to 9 meters
Others (Roads bordered by trees)	Less than 7.5 meters

#### Recommended Levels of Illumination (BIS 1944)

Type of Road	Road Characteristics	Average Level of Illumination on Road Surface in Lux	Ratio of Minimum/Average Illumination	Type of Luminaire Preferred
A-1	Important traffic routes carrying fast traffic	30	0.4	Cut-off
A-2	Main roads carrying mixed traffic like city main roads/streets, arterial roads, throughways	15	0.4	Cut-off
B-1	Secondary roads with considerable traffic like local traffic routes, shopping streets	8	0.3	Cut-off or semi-cut-off
B-2	Secondary roads with light traffic	4	0.3	Cut-off or semi-cut-off



### Lamp Technology

Type of Lamp	Luminous Efficacy (lm/W)	Color Rendering Properties	Lamp life in hrs	Remarks
Light Emitting Diode (LED)	>135 L/W at Tj 25 c	>70	100,000	High energy savings, low maintenance, long life, no mercury. High investment cost, nascent technology

**Overhang:** Overhang (see Figure 2 above) is the horizontal distance between the center of a luminaire mounted on a bracket and the adjacent edge of a carriage way. In general, overhang should not exceed one-fourth of the mounting height to avoid reduced visibility of curbs, obstacles, and footpaths

**Sitting of Luminaire:** Four fundamental types of sitting arrangements are recognized in street lighting (BIS 1981). They are:

- **Single side arrangement,** 1. Where all the luminaire are on one side of the road. This is recommended only when the width of the road is equal to or less than the mounting height.
- **Staggered arrangement,** 2. Where the luminaire are placed on either side of the road in a zigzag formation. This is recommended when the road width is 1 to 1.5 times that of the mounting height.
- **Opposite mounting,** 3. Where the luminaire are situated on either side of the road opposite to one another. This is advisable for road widths more than 1.5 times that of the mounting height.

- **Axial mounting**, 4. Where the luminaire are placed along the axis of the road. This is recommended for narrow roads the width of which does not exceed the mounting height.

### WHAT IS THE IP65/IP66 RATING?

The resistance offered by the fixture to the penetration of solids and liquids is indicated by the IP (Ingress Protection) rating. This is a two-digit number, the first number identifies the degree of protection against the ingress of solids and the second number against liquids. For example, IP65 indicates total protection against dust and protection against low jets of water.

	FIRST DIGIT PROTECTION AGAINST SOLIDS		SECOND DIGIT PROTECTION AGAINST LIQUIDS
	No Protection		No Protection
1	Protected against solid objects greater than 50mm (such as accidental contact with hand)	1	Protection against vertical water drops (such as condensation)
2	Protected against solid objects greater than 12mm (such as accidental contact with finger)	2	Protection against direct sprays of water, up to 15° from vertical
3	Protected against solid objects greater than 2.5mm (such as tools and wires)	3	Protection against direct sprays of water up to 60° from vertical
4	Protected against solid objects greater than 1 mm (such as fine tools and wires)	4	Protections against water spray from all directions
5	Protected against dust	5	Protection against low pressure jets of water from all directions
6	Total protection against dust	6	Protection against jets of water of similar to heavy seas
		7	Protection against immersion between 15 -100cm
		8	Protection against submersion

The LED Streetlight system consists of three parts:

1. LED
2. Luminaire
3. Driver

While the Table below provides the detailed specification of the various components and the test method, the testing protocol for all the three subcomponents are given as below:

#### (1)LED

- Single LED chip is allowed for a single category/wattage of product mixing of chip is not allowed for single product.
- LED report (for LED parameters like Lumen per watt , CCT , CRI , Beam Angle from accredited manufacture or TPL)
- LM 80/IS:16105 report (from accredited manufacturer or TPL)
- IEC 62471 and assessment of blue light as per IEC/TR 62778—Ed. 1.0

#### (2) Luminaire

- Type Tests report as per IS:10322 Part 5 sec-3 /IEC: 60598-2-3 from accredited TPL (IP classification is IP 65/ 66 , INSITU/Junction temp measurement shall be part of Thermal test)
- Test Report as per LM 79/IS:16106 from accredited TPL (IP classification is IP 65/66)
- Test report for IK 05 as per IS 10322

- Test report with summary for compliance as per tender parameters (Operating voltage, Constant light output, Luminous flux per watt, CCT, CRI, Uniformity calculation, P.F, Wattage, (For LED parameters like Lumen per watt, CCT, CRI, Beam Angle from accredited manufacture or TPL)
- LM 80/IS:16105 report (From accredited manufacture or TPL)
- Declaration and endorsement of BOM from Manufacture for components.

## (3) LED Driver

- Type Tests report as per IS:15885—Part 5 Sec-13, IS:16104.
- Test Report as per tender specification (Driver Efficiency, THD, Surge Protection > 4kV)

**TYPICAL SPECIFICATIONS OF LED STREETLIGHTS**

S No.	Type of Test/specification		Test Method
1	High bright white power LEDs shall be used in the luminaries and the wattage of these LEDs shall be >1 W and < 3W.		Specify make
2	Manufacturer shall submit proof of procurement of LEDs and LM-80 Test reports of specific LED used in the proposed Luminaire. (No other Chip details to be offered)		LM-80/IS 16105 Test report
3	Life span of LEDs used in the Luminaire shall be greater than 50,000 hours at 70% light output. (Manufacturer shall submit the proof)		LM-80 /IS 16105 test report
4	Manufacturer shall submit the Photo Biological Safety Report for the LEDs as per IEC 62471 and assessment of blue light as per IEC/TR 62778—Ed. 1.0		IEC 62471 and IEC/TR 62778—Ed. 1.0 Test report
5	LED chip efficiency shall be greater than 135 Lumens/watt at Tj 25 C (Manufacturer shall submit the proof)		LED Test report
6	Color rendering index (CRI) of the LEDs used in the luminaire shall be greater than 70		LM 80/16106 LED Test Report
7	Color temperature of the luminaire shall be made from 5000K to 6000K (CCT as per BIS only)		LM 79/IS 16105-2012
8	The distribution of luminaire illumination (control of distribution) shall be based on type of road as per BIS standard IS1944 refer table from NLC for Road category.		LM 79/IS 16105-2012
9	Manufacturer shall submit the LM-79/IS:16106test report from any of the NABL Accredited laboratory at the time of supply of the luminaries.		LM79/IS16105-2012
10	Power factor	> 0.95	LM79/IS16105-2012
11	System Efficiency (lumen/watt)	Shall be >85 lumen/watt, System lumen output supported by LM79 report shall be submitted.	LM79/IS16105-2012
12	CRI of Luminaries	> 70 (Supported by LM79 report shall be submitted.)	M79/IS16105-2012
13	Light Uniformity Ratio (Emin/Eavg) shall be as per IS 1944 based on category of road	Uniformity calculation for road width, pole height, and overhang width based on IES file generated by IES: LM 79/IS 16106 testing.	
14	The luminaire light output (lumen) shall be constant. The voltage variations / fluctuations in the specified voltage range shall not impinge		TPL/ Self NABL Acc. Lab report

	upon the lumen it produces. Maximum +/- 2% is allowed throughout in the input operating voltage range		
15	Operating voltage	140 V to 270V universal electronic driver with internal surge protection of 4 KV	TPL/ Self NABL Acc. Lab report
16	Total Harmonic Distortion	< 10% THD	Test Method IEC:610003-2
17	LEDs shall be operated at a current less than 90% of its rated current and should have LM80 approval on this current rating		TPL/ Self NABL Acc. Lab report
18	LED Drive current	>=350 mA<1000 mA	TPL/ Self NABL Acc. Lab report
19	LED driver efficiency	> 85%	TPL/ Self NABL Acc. Lab report
20	Luminaire body temperature shall not exceed 30 °C from the ambient, even after continuous operation of luminaire for 24 hours.		TPL/ Self NABL Acc. Lab Report
21	Heat dissipation / heat sink	Well-designed thermal management system with defined heat sink	INSITU/Thermal Test will cover this parameter Manufacture shall submit design/ drawing indicating maximum temperature point on LED array. This value shall not exceed junction temperature (Specified in LM 80 report at which life > 50000 hrs)
22	Junction Temperature (Tj)	Should be less than value at which LM80 (IS16105) data published.	CONFIRM, THIRD TEMP SHOULD BE MORE THAN 105
23	Luminaire shall be compliance to Type test as per IS: 10322 Part 5 Sec -3 /IEC:60598 -2-3		TPL / Self NABL Accredited TEST REPORT as per IS:10322 part 5 Sec-3 /IEC:60598-2-3
24	The luminaire housing shall be made up of corrosion free High Pressure Aluminum die cast thus conforming the luminaire to minimum IP-65 for Luminaire at 60 W or below/ IP-66 for Wattage above 60 W- protection and safety as per IEC 60598/IS 10322. (NABL accredited lab report supporting the same shall be furnished at the time of supply). Necessary Guarantee and Warranty certificate may be submitted at the time of bid submission. Multiple Fixtures are not allowed.		TPL/ Self NABL Accredited TEST REPORT as per IS:10322 part 5 Sec-3 /IEC:60598-2-3

25	The luminaire shall be equipped with distortion free, clear, heat resistant, toughened, UV stabilized glass cover in the front fixed to the die cast Aluminum frame which shall be fixed to the housing by means of stainless steel screws.		TPL/Seelf NABL Accredited TEST REPORT as per IS:10322 part 5 Sec-3 /IEC:60598-2-3
26	The luminaire shall be built in such a way that it can withstand wind speed of 150Kmph.NABL accredited lab report supporting the same shall be furnished by the manufacturer.		TPL/ Self NABL Accredited TEST REPORT as per IS:10322 part 5 Sec-3 /IEC:60598-2-3
27	Cover/glass without lens or with lens	Fixture cover—UV stabilized Polycarbonate / toughened glass or equivalent will be accepted for the Luminaire without lens. For the luminaire with lens-toughened glass, required with proper IP65 provision.	DECLARE
28	IP Protection	Optical and control gear compartment Minimum IP65 / 66 for respective wattages mentioned in sl. no. above or more (IS:10322)	TPL/ Self NABL Accredited TEST REPORT as per IS:10322 part 5 Sec-3 /IEC:60598-2-3
29	Frequency	50Hz +/- 3%	
30	Operating temperature	Range: -10C to +50C	As per IS:10322 Part 5 sec-3 sample will be tested at Ambient Temperature + 10 Deg C. Hence 60Deg C in this case.
31	Impact resistance	Impact resistance >= IK 07	TPL/ Self NABL Accredited TEST REPORT as per IS:10322 part 5 Sec-3 /IEC:60598-2-3
32	Protections	IP65 up to 60W and IP66 for wattage above 60W, Surge protection 4 kV, IEC61000-4-5	CONFIRM
33	Working humidity	10% to 90% RH	CONFIRM
34	Conformation standards of luminaire  (Test reports of luminaire)	The luminaire should conform to IEC 60598/ IS:10322 The luminaire should be tested as per IEC 60598-2-3:2002/ IS:10322 Part 5 Sec-3 standards and following test reports should be submitted: <ul style="list-style-type: none"> <li>▪ Heat Resistance Test, Thermal Test</li> <li>▪ Ingress Protection Test, Drop Test</li> <li>▪ Electrical / Insulation Resistance Test, Endurance Test, Humidity Test</li> <li>▪ Photometry Test (LM79 report), Vibration Test</li> </ul>	TPL/ Self NABL Accredited TEST REPORT as per IS:10322 part 5 Sec-3 /IEC:60598-2-3
35	Electrical safety as per IEC.	As per IEC safety standards. (IEC 60598/IS:10322)	TPL/ Self NABL Accredited TEST REPORT as per IS:10322 part 5 Sec-3 /IEC:60598-2-3
36	Driver specification	140-270 V universal electronic driver with Internal Surge protection of 4 kV.	TPL/ Self NABL Accredited TEST REPORT as per IEC:61000-4-5,
37	Correlated Color Temperature	The correlated color temperature shall be between 5000K and 6000K	LM79/IS16106-2012

38	Make of LED	NICHIA / CREE/ OSRAM/ PHILIPS	Manufacture to Specify and attach Warranty certificate
39	Third party endorsement / certification	LM80 (IS16105) NABL Acc. Lab certificate/ self-declaration for LED And LM79 (IS16106) , IEC60598/IS;10322for LED Luminaire	CONFIRM
40	Housing/body of fitting	Pressure die cast or extruded Aluminum housing with corrosion resistant polyester powder coated	DECLARE
41	Finish	Aesthetically designed housing with grey color corrosion resistant polyester powder coating	DECLARE
42	Luminaire configuration / technical requirement	Side entry type. Shall consist of separate optical and control gear compartments. It should be easy replaceable in the field condition.	DECLARE
43	Compliance	RoHS/CE/ERTL/ERDI	CONFIRM
44	Power Efficiency	>85%	CONFIRM
45	Driver		

*Note:* These LED Specifications are an indicative list and specification, since performance outputs related to these specifications will require localization and expert feedback to make it suitable for the local conditions and priority. This table provides with a format which requires more in-depth customization to suit individual project requirements.

\*Additional AMC of 3 Years (OPTIONAL FOR-Name of the Municipality)

NOTE: All tests must be confirmed and appropriate TEST REPORT from NABL Accredited laboratory which have to be submitted in Envelope II of Bid. Nonsubmission of the test report before the opening of the tender will disqualify the bidder in the technical Bid itself.

### Stage wise Quality Check Test for Successful Bidder: During Installation

S. No	Test Details	Sample Qty/ Test Condition	
1	Lighting testing, 1. Electrical (System Power, Power Factor, Supply Current) and Photometric (System Luminous Flux , System Efficacy) and Colorimetric (CCT, CRI, Co-Ordinate) measurement as per IS/16106: 2012	1	
2	Illuminance (Uniformity Verification (using IES file data) as per tender		
3	Lighting testing, Operating Voltage Range and Test for Constant Light Output as per tender		
4	Lighting testing, Measurement of Supply Current Total Harmonic Distortion (THD) as per tender		
5	Lighting testing, LED Driver Current and Efficiency as per tender		

6	Lighting testing, Thermal IN SITU test (luminaire body, LED shoulder point and LED driver case temperature) for 24 hrs as per tender		
7	Lighting testing, Type testing as per IS 10322 Part-5 Section-3/ IEC-60598-2-3(include Safety, Reliability, IP tests)	1	
8	Lighting testing, Surge Testing at 4kV as per tender	1	

Additionally LED related following reports shall be provided by manufacture.

- (A) LM80/IS: 16106
- (B) Photo biological Report as per IEC 62471 and IEC/TR 62778—Ed. 1.0 Test report
- (C) LED Chip (Efficacy, CCT and CRI) test report.

NOTE: -

1. Sample will be taken in presence of Vendor during the implementation of project and this will be signed by vendor at same place.
2. ESCO or Municipality is free to draw samples from the supplied quantity and subject the same to test in a NABL Accredited Lab. \_\_\_\_\_ (Name of the ESCO) will absorb the cost of testing of such sample. The decision of EESL on the same shall be binding on the vendor. Failure of the sample will strict penalty and disqualify the vendor from future tenders also.

## QUALITY AND WARRANTY

Components and parts used in White LED street lighting systems should conform to the latest BIS/ International specifications, wherever such specifications are available and applicable. A copy of the test report/ certificate stating conformity of BIS/ International standards must be submitted.

The successful bidder shall submit following information to \_\_\_\_\_ (Name of the ESCO) **(Please submit details as per Appendix C):**

- I. Test certificates of the raw materials and bought out accessories.
- II. Statement giving list of important raw materials, their grades along with names of subsuppliers for raw materials, list of standards according to which the raw materials are to be tested. List of tests normally carried out on raw materials in presence of bidder's representative.
- III. List of manufacturing facilities available.
- IV. Level of automation achieved and lists of areas where manual processing exists.
- V. List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspections.
- VI. In case of Self accredited Laboratory report the list of testing equipment available with the Manufacturer for final testing of equipment along with valid calibration reports. b) The manufacture shall submit manufacturing quality plan (MPQ) for approval and the same shall be followed during manufacture and testing.
- VII. Bidder shall be an Indian manufacturer having In-house electronics manufacturing and fixture assembly process. He should have In-house SMT and wave soldering setup. Bidder should have adequate testing facilities to conduct electrical, optical, thermal and environmental tests.

### Test certificates:

Type Test certificates: The type test certificates of LED lamps not later than 5 years old shall be furnished to the owner.

Routine /Acceptance Tests:

- The routine test of the all the materials shall be conducted in presence of the authorized representative unless inspections are waived and obtain dispatch instructions from before dispatch of materials to site for erection.

- The acceptance of the quality of material shall in no way relieve the supplier of his responsibility for meeting all the requirements of the specifications and shall not prevent subsequent rejection, if such materials are later found to be defective.

## DOCUMENTATION

(i) An Operation, Instruction and Maintenance Manual, in English and the local language, should be provided with the street lighting system. Besides other information the manual should contain the following minimum details:

- About White LED street lighting system -its components and expected performance The make, model number, country of origin and technical characteristics of W-LEDs should be stated in the product data sheet.
- Clear instructions about mounting on Pole, and luminaire. Clear wiring instructions with line diagram.
- DOs and DON'Ts.
- Clear instructions on regular maintenance and troubleshooting of the system.
- Name and address of the person or service center to be contacted in case of failure or complaint.

## ANNEXURE A

### UNDERTAKING OF COMPLIANCE

*(To be submitted in Envelope-II along with Techno-Commercial bid)*

S. No.	Technical Specifications	Compliance	Supporting Document as mentioned in Tech. Specs.(Title of the Document)	Indexed Page no. in the bid document to be referred to confirm the compliance
1		Yes/No		
2				
3				
4				

***All pages of the bid should be properly numbered and indexed.***

**ANNEXURE B**

*To be submitted periodically by successful party on whom LOA/ PO will be placed)*

INSTALLATION DETAILS OF STREETLIGHTS AT (Name of the Municipality)

S. No.	DATE	SR.NO.OF LIGHT	PRESENT LIGHT WATTAGE	REPLACED LIGHT WATTAGE	ROAD NAME	LOCATION OF LIGHT POLE
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						

Signature

**ANNEXURE C****CHECK LIST OF SUPPORTING DOCUMENTS TO BE SUBMITTED***(To be submitted in Envelope II along with Techno-Commercial Bid)*

S. No.	Description	Compliance	Supporting Document as mentioned in Tech. Specs.(Title of the Document)	Indexed Page no. in the bid document to be referred to confirm the compliance
1	Test report of raw materials purchased	Yes/No		
2	Test report of bought out accessories			
3	Statement of important raw materials purchased, grade, name of subsupplier, list of standards for testing these materials, list of test normally carried in presence of bidder's representative			
4	List of manufacturing facilities available			
5	Level of automation achieved in manufacturing and list of areas where manual processing exists			
6	List of areas where stage inspections area carried out in manufacturing and details of such tests and inspections			
7	For self-accredited Lab, list of equipment available with valid calibration certificates			
8	Manufacturing Quality Plan to be submitted for approval and confirmation from Bidder that MQP will be complied to during manufacturing and testing			
9	Proof of having domestic in-house manufacturing and fixture assembly process of LED streetlights with In-house SMT and wave-soldering set-up			
10	List of testing facilities to conduct electrical, optical, thermal and environmental tests			
<b>All pages of the bid should be properly numbered and indexed.</b>				

## SPECIAL CONDITIONS OF CONTRACT

### SPECIAL CONDITIONS WILL PREVAIL UPON THE INSTRUCTION TO BIDDERS AND OTHER TERMS AND CONDITIONS.

#### Terms of Payment (Indicative)

#### For supply, dismantling, installation, commissioning and transportation:

S. No.	Amount (in % of contract value)	Milestone
1	10 %	- Signing of contract agreement between ____ (Name of the ESCO) and successful bidder. - Submission of an unconditional Contract Performance Guarantee in the form of Demand Draft/ Pay Order or Bank Guarantee of 10% of the total contract value. The Bank Guarantee must be valid to cover Delivery Period + Warrantee Period + Three Months Claim Period.
2	70%	- Delivery of all lights, testing/ installation and commissioning of work— Verification by ____ (Name of the ESCO)
2	20 %	- After completion of 60 days of satisfactory performance of all lights, subject to joint verification by _____ (Name of the ESCO) and MC representatives.

#### 1.02 For comprehensive on-site additional warranty and maintenance for 3 years:

The payment toward comprehensive on-site additional warranty and maintenance for 3 years shall be paid in three equal installments at the end of each successful year on Certification from by Engineer-in-Charge.

\_\_\_\_\_ (Name of the ESCO) has the right to seek any additional documents / information / certification it deems fit prior to be release of any installment. Income tax shall be deducted as applicable under the rules.

Please note that in price-bid table 1 and table 2, cost of part B [comprehensive additional on-site warranty and maintenance of LED Lights and Fixtures for 3 Years] should not be less than 7.5% of the cost of Part A [Supply of LED Street Light and Fixtures for \_\_\_\_\_ (Name of the Municipality), Dismantling, Testing, Installation, Commissioning, Inland transportation, and insurance]. In case, quoted price for Part B is less than 7.5% of part A, then \_\_\_\_\_ (Name of the ESCO) at its sole discretion may retained the differential amount from supply part. This retained amount will be released along with the comprehensive on-site additional warranty and maintenance payment for 3 years over the period of 3 years.

#### 2.0 Price Basis

**To be quoted at FOR Destination Basis, which is LED Street Light Fixtures at \_\_\_\_ (Name of the Municipality). The supplier is responsible for installation of new fixtures after dismantling the old ones.**

#### 3.0 Adjudicator:

Adjudicator under the contract shall be appointed by the Appointing Authority, that is, the CEO (Name of the ESCO). If the bidder does not accept the Adjudicator proposed by EESL, it should so state in its bid form and make a counter proposal of an adjudicator. If on the day the contract agreement is signed,

the \_\_\_\_\_ (Name of the ESCO) and contractor have not agreed on the appointment of adjudicator, the adjudicator shall be appointed, at the request of either party, by the appointing authority specified.

#### **4.0 Arbitration:**

Arbitration shall be carried out as per Arbitration Act 1996 and its subsequent amendment.

The Contract shall be governed by and interpreted in accordance with the laws in force in India. The courts of Delhi shall have exclusive jurisdiction in all matters arising under the contract.

#### **5.0 Completion Time:**

Entire material to be delivered, installed, tested and commissioned with-in 18 days from the date of issue of Purchase Order. **Only Bidders who are able to meet this deadline of commissioning the streetlights on-site by 30.09.14 need apply. Bidders must give sufficient evidence about their readiness to deliver on this commitment indicating availability of ready stock after testing and/ or scheduled dates by which the tendered quantity will be commissioned on site including manufacturing date, testing completion date, dispatch date and commissioning-on-site date.**

Time Schedule includes the time required for mobilization as well as testing, rectifications if any, retesting and completion in all respects to the entire satisfaction of the Engineer-in-Charge.

#### **6.0 Contract Performance Guarantee:**

Within twenty eight (28) days of the receipt of notification of award from \_\_\_\_\_ (Name of the ESCO), the successful bidder shall furnish the CPG in the form of Demand Draft/ Pay Order or Bank Guarantee for 10% of the total contract value as per instructions contained in Section-2 [Instruction to Bidders]. The Bank Guarantee must be valid to cover Delivery Period + Warrantee Period + Three Months Claim Period.

Bank guarantee shall be from any Nationalized Banks/other scheduled private banks as per list given in Section 4. \_\_\_\_\_ (Name of the ESCO) shall at his discretion have recourse to the said Bank Guarantee for the recovery of any or all amount due from the bidder in connection with the contract including of guarantee obligations.

Failure of the Successful Bidder to comply with the requirements of IFB/RFP shall constitute sufficient grounds for the annulment of the award and forfeiture of the Contract Performance Guarantee.

#### **7.0 Pre-bid conference:**

Pre-Bid meeting is proposed on the \_\_\_\_\_ (Date) and \_\_\_\_\_ (Time). Venue of the Pre Bid is at \_\_\_\_\_ (Full address of the Pre-Bid Conference Venue)

#### **8.0 Warranty and Maintenance:**

**As defined above.**

#### **9.0 \_\_\_\_\_ (Name of the ESCO) reserve the right for quantity variation up to +/-20%**

**10.0** Successful bidder, on whom letter of award is placed, is to ensure that all safety guidelines, rules and regulations, and labor laws are adhered to. Successful bidder indemnifies \_\_\_\_\_ (Name of the ESCO) for any accident, injury met by its labor, employee or any other person working for him. Any compensation sought by its labor, employee or any other person working

for him shall be paid by successful bidder as per settlement solely. \_\_\_\_\_ (Name of the ESCO) has no role to play in this matter.

**11.0** Successful bidder is to submit interchangeability certificate for its product supplied for replacement during warranty and maintenance period and even when it is purchased from open market. If, because of a change in technology, the supplied product is not available during warranty/ maintenance period, the improved version of product can be used during the warranty/ maintenance period with the same or improved technical parameters or the combination thereof after written communication of Engineer in Charge at same cost and terms and conditions. Successful Bidder, on whom letter of award has been placed, has also to confirm that the prices of improved version of product are not lesser than the original product or its parts in comparison.

**12.0** The Bidder shall be deemed to have examined the Bid document, to have obtained his own information in all matters whatsoever that might affect carrying out the Works in line with the Scope of Work specified in the document at the offered rates and to have satisfied himself to the sufficiency of his Bid. The bidder shall be deemed to know the scope, nature and magnitude of the work and requirement of materials, equipment, tools and labor involved, wage structures and as to what all works he has to complete in accordance with the Bid documents irrespective of any defects, omissions or errors that may be found in the Bid documents.

**13.0** Insurance: The Goods supplied under the Contract shall be fully insured in Indian Rupees against loss or damage incidental to manufacture or acquisition, transportation, storage and delivery. For delivery of goods at site, the insurance shall be obtained by the Contractor, for an amount not less than the Contract Price of the goods from **"warehouse to warehouse" (final destinations) on "All Risks" basis including War risks and strikes.**

**14.0** Transportation and Demurrage Wharfage:

Contractor is required under the Contract to transport the Goods to place of destination defined as Site. Transport to such place of destination in India including insurance, as shall be specified in the Contract, shall be arranged by the Contractor, and the related cost shall be included in the Contract Price.

**15.0** Subsequent to an order being placed against your quotation, received in response to this "enquiry," if it is found that the materials supplied are not of the right quality or not in accordance with our specifications (required by us) or received in damaged or broken conditions, not satisfactory owing to any reason of which we shall be the sole judge, we shall be entitled to reject the materials, cancel the contract and buy our requirement from the open market / other sources and recover the loss, if any, from the supplier reserving to ourselves the right to forfeit the security deposit, furnished by the supplier against the contract. The supplier will make his own arrangements to remove the rejected material within a fortnight of instruction to do so. Thereafter, **material will lie entirely at the supplier's risk and responsibility** and storage charges, along with any other charges applicable, will be recoverable from the supplier.

**16.0** We reserve the right to accept or reject any quotation in full or in part without assigning any reason thereof. We also reserve the right to split and place order on more than one supplier.

**17.0 EVALUATION CRITERION:**

Selection of the bidder will be done on the technically acceptable and L-1 (Lowest One) price basis. Bidders to quote for all items. Otherwise, their bid will be rejected.

**18.0** The bidder should not have been black-listed by any Central / State Government or Public Sector Undertakings. If at any stage of tendering process or during the currency of the contract,

any suppression / falsification of such information is brought to the knowledge, EESL shall have the right to reject the proposal or terminate the contract, as the case may be, without any compensation to the tenderer and forfeiture of bid security/EMD/CPG.

**On behalf of EESL**

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**Signature  
(Designated Authority)**

**MODEL TEMPELATE FOR PRICE BID TABLE 1: (Name of the Area)****NIT/Bid Document No.:****Dated:****Name of Work: SUPPLY, INSTALLATION (RETROFIT), TESTING, COMMISSIONING, WARRANTY, MAINTENANCE OF LED STREETLIGHTS AND RELATED WORKS AT \_\_\_\_\_ (Name of the Municipality).**

Sl. No	Description of Work	Proposed quantity (Nos.)	Price per Unit	Applicable Taxes and duties {such as CST, VAT and Service Tax) (Rs.)	Price including taxes for Proposed Quantity (Rs.)	Total Price for complete Scope of Work (Rs.)
			Ex. Works Price including ED (Rs.)			
A	Supply of LED Street Light and Fixtures for _____ (Name of the Municipality)—Hyderabad including comprehensive on-site warranty and maintenance for 2 years [as per Technical Specifications defined in Scope of Work]	2	3	4	5 (3+4)	6= (2x5)
A1	70W-85W wattage LED Lights to replace 150 W SVL/ MHL	279				
A2	120W-130W wattage LED Lights to replace SV 250 W for 12 M wide road and 9 M Pole height	180				
A3	Dismantling, Installation and commissioning of above LED Lights and Fixtures	459				
A4	Inland transportation including loading, unloading and transfer to Site, insurance and other costs incidental to delivery	459				
	<b>Subtotal—A (A1+A2+A3+A4)</b>					
B	Comprehensive on-site additional warranty and maintenance of above LED Lights and Fixtures for 3 Years	459				

	<b>Subtotal: B</b>					
	<b>Grand total: A+B</b>					
<b>Rs (In Words):</b>						

**MODEL TEMPELATE FOR PRICE BID TABLE 2:(Name of the Area)**

Sl. No	Description of Work	Proposed quantity (Nos.)	Price per Unit	Applicable Taxes and duties {such as CST, VAT and Service Tax) (Rs.)	Price including taxes for Proposed Quantity (Rs.)	Total Price for complete Scope of Work on FOR (Rs.)
			Ex. Works Price including ED (Rs.)			
<b>A</b>	Supply of LED Street Light and Fixtures for ____ (Name of the Municipality) including comprehensive on-site warranty and maintenance for 2 years [as per Technical Specifications defined in Scope of Work]	2	3	4	5 (3+4)	6= (2x5)
<b>A1</b>	150W-170W wattage LED Lights to replace SV 250 W for 15 M wide road and 12 M Pole height	289				
<b>A2</b>	Dismantling, Installation and commissioning of above LED Lights and Fixtures	289				
<b>A3</b>	Inland transportation including loading, unloading and transfer to Site, insurance and other costs incidental to delivery	289				
	<b>Subtotal—A (A1+A2+A3)</b>					
<b>B</b>	Comprehensive on-site additional warranty and maintenance of above LED Lights and Fixtures for 3 Years	289				
	<b>Subtotal; B</b>					
	<b>Grand total: A+B</b>					

Rs (In Words):

**OFFER FOR ANNUAL MAINTENANCE CHARGES (AFTER 5 YEAR WARRANTY)—OPTIONAL FOR \_\_\_\_\_ (Name of the Municipality) TO AVAIL THIS OFFER—SHALL NOT BE CONSIDERED BY EESL AS PART OF PRICE BID FOR FINALIZING SUCCESSFUL BIDDER.**

S. No.	Description		AMC per Year	Taxes (Service Tax)	Total Unit Price with taxes per	Total Price for 3 years
1	Complete system Annual Maintenance Contract for 3 years after 5 years comprehensive on-site warranty and maintenance	For ____ (numbers of lights) Lights				
<b>Total</b>						
Rs (In Words):						

**Note:**

- 1 Please note that in price-bid table 1 and table 2, cost of part B [comprehensive additional on-site warranty and maintenance of LED Lights and Fixtures for 3 Years] should not be less than 7.5% of the cost of Part A [Supply of LED Street Light and Fixtures for \_\_\_\_\_ (Name of the Municipality), Dismantling, Testing, Installation, Commissioning, Inland transportation, and insurance]. In case, quoted price for Part B is less than 7.5% of part A, then \_\_\_\_\_ (Name of the ESCO) at its sole discretion may retained the differential amount from supply part. This retained amount will be released along with the comprehensive on-site additional warranty and maintenance payment for 3 years over the period of 3 years.
- 2 If there is a discrepancy between words and figures, the amount written in words will prevail.
- 3 Any other item as required for commissioning the system for reliable and efficient operation to be provided within the quoted price.
- 4 All the above prices are inclusive of all applicable taxes and duties, including service tax, loading/unloading/installation and commissioning, lodging and boarding, and travel expenses.
- 5 **The present rate of taxes and duties considered in your offer may be indicated separately.**
- 6 The bidder shall submit PAN and Service Tax Registration Certificate in support of claim of service tax.
- 7 Please note that selection of the bidder will be done on the technically acceptable and L-1 (Lowest One) price basis. Price-Bid shall be evaluated for each Table1: \_\_\_\_\_ (Name of the Project Area) and Table 2: \_\_\_\_\_ (Name of the Project Area) separately, that is, the bidder who has quoted lowest for complete scope of work for Table 1: \_\_\_\_\_ (Name of the Project Area) and Table 2: \_\_\_\_\_ (Name of the Project Area) shall be awarded the work respectively.
- 8 Bidders to quote for all items otherwise their bid will be rejected.
- 9 **Prices will remain firm till the execution of the contract.**
- 10 **\_\_\_\_\_ (Name of the ESCO) does not issue any concessional sales tax form C or D or any other form.**
- 11 **\_\_\_\_\_ (Name of the ESCO) does not issue any Road Permit.**

I/We have read all the terms and conditions of the RFP/IFB and the annexure(s) thereto and agree to accept and abide by the same in toto. The above quotation has been prepared after taking into account all the terms and conditions of the RFP/IFB.

Dated:

*(SEAL)*

Signature of Tenderer or  
Their Authorized Representative: \_\_\_\_\_

Name and Address of Tenderer:  
\_\_\_\_\_

Phone No: \_\_\_\_\_

Fax no.: \_\_\_\_\_

E-Mail: \_\_\_\_\_

## Appendix D: Outline of a Template for ESPC

**Cover page with ULB name, logo and contact details**

### PERFORMANCE CONTRACT FOR ENERGY EFFICIENCY SERVICES

This CONTRACT (hereinafter called the "Contract") is made the \_\_\_ day of the month of \_\_\_\_\_, 20\_\_\_, between, on the one hand, M/s. [Municipality] and having its registered office at [Legal Address], herein after referred to as the "**Municipal Facility**," (which expression shall, unless excluded by or repugnant to subject or context thereof, include its successors or assigns), and on the other hand, M/s. \_\_\_\_\_, a company registered under Companies act 1956, having its registered office at \_\_\_\_\_, hereinafter called the "**Contractor**," (which expression shall, unless excluded by or repugnant to subject or context thereof, include its successors and assigns,

WITNESSETH THAT:

WHEREAS, the Municipality owns or leases the **Municipal Facility**;

WHEREAS, **Contractor** provides all services and equipment that would be required to reduce energy consumption in facilities.

WHEREAS, **Contractor** has submitted a written proposal in response to the **Municipal Facility's** request and has been selected by the **Municipal Facility** as the most qualified **Bidder** for the work herein described;

NOW THEREFORE, in consideration of the mutual promises hereinafter set forth, the parties agree as follows:

#### 1. Definition

<Key terms used within this contract are defined in this section.>

#### 2. Contract Documents

##### 2.1. Documents Included

<This section lists all the documents which form part of the current contract, these include documents like, RFP, General terms and conditions for goods and services, special terms and conditions of the contract, the energy study report to be executed by the contractor, the energy study report form.>

#### 3. Contractor's Services *<this section includes the services to be provided by the contractor under the agreement. This could include the following>*

##### 3.1. Energy Study and baseline determination

*<Mentions responsibilities related to the energy study and baseline assessments>*

##### 3.2. Equipment Design and Construction

<instructions related to implementing energy savings measures are included in this section>

##### 3.3. Notice of Completion

*<instructions related to providing a written notice to the Municipality on completion of the ESMs>*

### **3.4. Maintenance and Repair of ESMs**

*<details regarding responsibility of the contractor for maintaining and repairing the ESMs>*

### **3.5. Operation and Maintenance Manuals and Training**

*<Details on providing operation and maintenance manuals and training to the Municipality by the contractor.>*

## **4. Responsibilities of the Municipal Facility**

*<this section of the contract highlights the responsibilities of the Municipality with regard to the project. It includes information on the processes, timelines and roles performed by the Municipality under the specific responsibility area. The key responsibilities could include the following.>*

### **4.1 Reviews and Approvals**

### **4.2 Equipment Locations and Access**

### **4.3 Operations and Maintenance of Equipment**

## **5. Compensation**

*<this section provides details on energy study fee to be given to the contractors by the Municipality and as well as the sequence of payments to be made to the contractor.>*

### **5.1. Energy Study Fee**

### **5.2. Payments**

## **6. Terms and Termination**

*<provides details on notice period and terms for termination of the contract>*

### **6.1. Agreement Subject to Appropriation**

### **6.2. Termination for Convenience**

### **6.3. Contract Term**

## **ANNEX I**

### **GENERAL TERMS and CONDITIONS FOR GOODS AND SERVICES**

#### **GENERAL PROVISIONS**

1. Ownership of Contractor-Installed Equipment
2. **Protection of Lien Holder's Interest**
3. Subcontracting
4. Responsibility for Contractor-Installed Equipment
5. Equipment Location and Access
6. Installation of ESMS
7. Operation of ESMS
8. Maintenance of ESMS
9. Damage to or Failure of Equipment
10. Contractor Maintenance and Repair Response Time
11. Training for Municipal Facility Personnel for Operation and Maintenance of Installed ESMS.
12. **Municipal Facility's Projects**
13. Standards of Service and Comfort
14. Material Changes and Baseline Modifications
15. Insurance
16. Force Majeure

17. Events of Default
18. Remedies upon Default
19. Representations and Warranties
20. Choice of Law
21. Laws to Be Observed
22. Notices
23. No Waiver
24. Supplemental Agreement
25. Indemnification
26. Transfer, Sale or Merger of Contractor
27. Disputes

## **ANNEX 2**

### **SPECIAL TERMS AND CONDITIONS OF CONTRACT**

1. Other Conditions which are not covered under the General Conditions as given at Annex 1
2. Completion Period
3. Compensation for Delay in the Implementation of the ESMs
4. Extension or Time
5. Approval of Personnel
  - 5.1. *Removal and/or Replacement of Personnel*
6. Requirement of Performance and Payment Bonds
  - I. Performance Guarantee
  - II. Payment Guarantee

## **ANNEX 3**

### **FORM OF ENERGY STUDY REPORT**

1. Cover
2. Table of Contents
3. Page Numbers and Revisions
4. Executive Summary
5. Existing Conditions
6. Energy Efficiency Measures (ESMs)
7. Energy Savings Proposed
8. Municipal Facility Support Required
9. ESM Installation Schedule
10. Hazardous Waste Disposal Plan
11. Energy Baseline and Savings Measurement
12. Description of Maintenance Services and Training
13. Pricing and Project Financing
14. Calculations

## **ANNEX 4**

### **ENERGY STUDY REPORT ACCEPTANCE FORM**

# **Appendix E: Implementation Agreement for EE Street Lighting Project based on Deemed Savings Model**

**LED STREETLIGHT PROJECT IMPLEMENTATION  
AGREEMENT**

**between**

---

**(Name of MUNICIPAL CORPORATION),**

\_\_\_\_\_ **(Area-CITY)**

**And**

---

**(Name of SERVICE PROVIDER)**

\_\_\_\_\_ **(Area- City)**

This Agreement is entered into on this the \_\_\_\_ day of \_\_\_\_\_ <Year>

### **Between**

The \_\_\_\_\_, having its office at \_\_\_\_\_, acting through its **Representative** \_\_\_\_\_ (hereinafter referred to as the "Municipality" which expression shall, unless the context otherwise requires, include its administrators, successors and assigns) of Second Part;

### **And**

M/s \_\_\_\_\_ (Name of SERVICE PROVIDER/BIDDER), a Company \_\_\_\_\_ (Description of SERVICE PROVIDER/BIDDER with ADDRESS) through its Representative \_\_\_\_\_ (hereinafter referred to as the "SERVICE PROVIDER/BIDDER" which expression shall, unless the context otherwise requires, include its administrators, successors/successors in business and permitted assigns and substitutes) of the Third Part.

As the context may require, the Municipality, and the SERVICE PROVIDER/BIDDER, may hereinafter be referred to individually as a "Party," and collectively as the "Parties."

### **WHEREAS:**

- A. The Municipality is desirous to implement EE in the area under the Municipality by interventions in the present illumination of xxx (number) street light consisting of [T5 Fittings, and HPSV and Metal Halide lamp fittings]. The Municipality in its drive to reduce its energy consumption on account of street lighting has decided to replace the existing streetlights with modern and energy-efficient LED luminaries.
- B. As a prelude to the above objective the Municipality invited SERVICE PROVIDER/BIDDER to undertake the supply of LED streetlights giving output of lux levels / lumen output equivalent to the existing lights, which shall include their installation, maintenance and warranty replacement during the project period on the principle of repayment of the cost of the project by the \_\_\_\_\_ in monthly installments on the basis of cost reimbursement. In response thereto, SERVICE PROVIDER/BIDDER has agreed to install the latest LED street light technology as replacements to the existing lights.
- C. Accordingly the \_\_\_\_\_ issued Letter of Award bearing No: \_\_\_\_\_ dated \_\_\_\_\_ to the "SERVICE PROVIDER/BIDDER" requesting, inter alia, the execution of this Agreement which the "SERVICE PROVIDER/BIDDER" as acknowledged through the Letter of Acceptance No. \_\_\_\_\_ dated and agrees to implement the Project in accordance with the terms and conditions of this Agreement.
- D. The \_\_\_\_\_ acknowledges and confirm that this agreement is irrevocable notwithstanding any change in the Municipality in its administrative setup. The Municipality further confirms that this agreement shall cease only after completion of payment by it to the "SERVICE PROVIDER/BIDDER" and on "SERVICE PROVIDER/BIDDER" discharging all the obligations as required in terms of this Agreement.

NOW THEREFORE, in view of the offer, mutual promises and consideration set out herein, the Municipality and the "SERVICE PROVIDER/BIDDER" (each individually a "Party" hereto, and collectively the "Parties") hereby agree to be bound by the provisions of this Agreement.

### **ARTICLE 1: DEFINITIONS AND INTERPRETATION.**

## Definitions

In this Agreement, unless repugnant to the context in which these words and expressions appear the words and expressions defined below shall have the meanings assigned to them: -

(i) **"Agreement"** means and includes this signed Agreement including the appendixes of the Agreement, the **"Notice of Award" issued by the Municipality, the written clarification(s), addendum, amendments,** all other document/papers attached as annexure/appendix and the Bid documents.

(ii) **"Agreement Period"** is the period from the date of signing this Agreement till completion of payment of all dues by the Municipality to the **"SERVICE PROVIDER/BIDDER"** in terms of this Agreement or till termination of this Agreement as set out in the Articles: 13 and 14 of this Agreement.

(iii) **"Annexures"** mean the additional documents specifically mentioned in this Agreement.

(iv) **"Applicable Laws"** means all laws which are applicable to the Project and/or extending to the State of \_\_\_\_\_ (Name of STATE), having been enacted or brought into force by Government of India or Govt. of \_\_\_\_\_ (Name of STATE) including regulations and rules made there under, and judgments, decrees, injunctions, writs and orders of any Court of Record, as may be in force and effect during the subsistence of this Agreement.

(v) **"Associates"** means in relation to either Party and/or Joint Venture (JV) Members, a person who controls, is controlled by, or is under the common control with such Party or Joint Venture (JV) Member as used in this definition, the expression **"control"** means with respect to a person which is a corporation, the ownership, directly or indirectly, of more than 50% of the voting shares of such person, and with respect to a person which is not a corporation, the power to direct the management and policies of such person, whether by operation of law or by contract or otherwise.

(vi) **"BOT"** means the replacement, maintenance, and monitoring of LED streetlights on the cost reimbursement principle.

(vii) **"Change in Law"** means the occurrence of any of the following events after the Compliance Date:

- (a) Enactment of any new Law.
- (b) The repeal in whole or in part (unless re-enactment with the same effect) or modification of any existing Law.
- (c) The commencement of any Law, which has not yet entered into effect.
- (d) The change in interpretation or application of any Law by a Court of Record.
- (e) The imposition or requirement for a new statutory or regulatory approval of a modification in the terms and conditions on which a statutory approval has already been obtained.
- (f) A fresh imposition of a tax or duty or cess that was not in existence on the Proposal Acceptance Date. It is specially clarified that a change in the rate of a tax or duty shall not be considered a Change in Law for the purpose of this Article if the tax or duty itself was in existence on the Proposal Acceptance Date.

(viii) **"Clearance"** means, as on the date of execution of this Agreement, any consents, licenses, approvals, permits, exemptions, registrations, filings or other of whatever nature, which is necessary for effective implementation of the project.

(ix) **"Competent Authority"** means any agency, authority, department, ministry, public or statutory Person of the Government of \_\_\_\_\_ (Name of STATE) or Government of India; any local authority; or any other subdivision thereof with authority over aspects of implementation of the Project having jurisdiction over all or any part of the Project Facility or the performance of all or any of the services or obligations of the **"SERVICE PROVIDER/BIDDER"** under or pursuant to this Agreement.

(x) **"Compliance Date"** means the date of signing this Agreement by the parties.

(xi) **"Conditions Precedent"** means the conditions set out in Article: 6 hereof.

(xii) **"Consideration amount"** means the amount payable to the **"SERVICE PROVIDER/BIDDER"** on account of supply of materials as per this agreement which represents cost of material, cost of finance, cost of warranty and applicable taxes and duties as detailed in Article 4 of this agreement.

(xiii) **"Cost of the Project"** means the cost incurred by the **"SERVICE PROVIDER/BIDDER"** for implementation of the project and which has to be repaid by the Municipality on monthly installments to the **"SERVICE PROVIDER/BIDDER,"** which shall include the cost of the material, cost of maintenance, cost of warranty, the duties and taxes as applicable and also the financial cost arising out of deferred payment.

(xiv) **"Date of Completion of Supplies"** the date of receipt of last batch of supplies by Municipality under this agreement.

(xv) **"Day"** means calendar day, **"Month"** means 30 (thirty) days and **"Year"** means 365 days.

(xvi) **"Design Documents"** means and includes all drawings, calculations, computer application software (programs), samples, patterns, models and other manuals and information of a similar nature prepared in relation to the installation and operation of Energy-Efficient LED Streetlights.

(xvii) **"Directive"** means any present or future requirement, instruction, direction, order, rule or regulation issued by any Competent Authority which is legally binding or which is notified by the \_\_\_\_\_, and any modification, extension or replacement thereof from time to time in force.

(xviii) **"Dues"** means the unpaid amount of the consideration amount payable to the **"SERVICE PROVIDER/BIDDER"** as shown in Annexures XX to YY of this agreement.

(xix) **"Encumbrances"** means any encumbrances such as mortgage, charge, pledge, hypothecation, security, interest, assignment, privilege or priority of any kind having the effect of security or other such obligations and shall include without limitation any designation of loss payees or beneficiaries or any similar arrangement under any insurance policy pertaining to the Energy Efficiency Lights implanted within the Project Facility.

(xx) **"Engineer in charge"** means an engineer appointed by the Municipality for the particular sector.

(xxi) **"Financial Model"** means the financial model on deferred payment basis as detailed in Article: 4 of this Agreement.

(xxii) **"Financial Year"** means the year commencing from 1st April of any calendar year to the 31<sup>st</sup> March of the next calendar year except in the first and the last calendar year of the subsistence of this Agreement. In the first year of subsistence of this Agreement, it shall mean the period from the Compliance Date to 31st March, it means the period from 1st April to the Transfer Date.

(xxiii) **"Force Majeure"** or **"Force Majeure Event"** shall mean an act, event, condition or occurrence specified in the Article 15.

(xxiv) **"Good Industry Practice"** means those practices, methods, technique standards, skill, diligence and prudence which are generally and reasonably expected and accepted from a reasonably skilled, prudent and experienced manufacturer engaged in manufacturing of LED streetlights and supplying to projects akin to the Project covered under this Agreement. It would include good practices in the design, which would be expected to result in the performance of its obligation by the **"SERVICE PROVIDER/BIDDER"** in accordance with this Agreement and Applicable Laws.

(xxv) **"Implementation Completion Certificate"** means the certificate to be issued by the Municipality in favor of the **"SERVICE PROVIDER/BIDDER"** on completion of installation of all the LED streetlights in respective Sectors in terms of this Agreement.

(xxvi) "Implementation Period" or "Time for Completion of implementation" means the period of xx months from the date of compliance of conditions precedent in terms of Article 6 of this agreement.

(xxvii) "Light Point" means a fully erected pole with an arm for mounting street light and live electrical cable, which is sufficient for connecting the luminary.

(xxviii) "Material Adverse Effect" means consequences of events outside the control of the Affected Party which (a) render any right vested in a Party by the terms of his Agreement ineffective, or (b) significantly impairs or frustrates the ability of any Party to observe and perform in a timely manner its obligations under this Agreement, or (c) frustrates a material provisions of this Agreement or any of the Project Agreements.

(xxix) "Party" means any of the parties to this Agreement.

(xxx) "Person" means any natural person, firm, corporation, company, partnership, joint venture, trust or other entity, having legal capacity to sue and be sued in its name.

(xxxi) "Project Agreements" means, collectively, this Agreement, the Financing Documents, Implementation Agreements and Operation and Maintenance Agreements, if any, in each case as entered into, amended, supplemented or otherwise modified from time to time.

(xxxii) "Project In-charge" means an engineer appointed by Municipality for the monitoring the total project.

(xxxiii) "Project Insurance" means the insurance taken out by or on behalf of the Municipality and/or the "SERVICE PROVIDER/BIDDER" pursuant to the provisions of this Agreement.

(xxxiv) "Proposal Acceptance Date" means the date of signing of this Agreement.

(xxxv) "Subcontractor" means the implementation contractor(s) and/or operation and maintenance contractor(s) and/or any other contractors and, subcontractors, or "SERVICE PROVIDER/BIDDER" of services or equipment or part thereof, as the context may require, to whom the "SERVICE PROVIDER/BIDDER" contracts or subcontracts the Works or part.

(xxxvi) "Statutory Auditors" means an Independent, recognized and reputable firm of the chartered accountants duly licensed to practice in India acting as the Independent statutory auditors of the "SERVICE PROVIDER/BIDDER" under the provisions of Companies Act, 1956, including any statutory modification or re-enactment or replacement thereof, for the time being in force.

(xxxvii) "Tax" means any tax, duty, levy, or toll charge whatsoever charged, imposed or levied under Applicable Laws.

(xxxviii) "Proposal" means the SERVICE PROVIDER/BIDDER's quoted Financial Proposal including the SERVICE PROVIDER/BIDDER's Proposal submitted to the Municipality and as accepted by the Municipality.

(xxxix) "Termination Date" means the date on which this Agreement terminates upon completion of payment of all dues of the "SERVICE PROVIDER/BIDDER" by the Municipality and discharge of the obligations by the "SERVICE PROVIDER/BIDDER" in terms of this agreement or as indicated in clause 13 of this agreement.

(xl) "Termination Payment" means the amount payable by the Municipality to the "SERVICE PROVIDER/BIDDER" upon the termination of this Agreement and shall consist of payments relating to deferred payment, and associated financial costs as the case may be, and other such amounts as are expressly-provided for under Articles: 14 and 15.

(xli) "Third Party" means any Person, real or judicial, or entity other than the Parties to this Agreement.

(xlii) Principles of Interpretation. In this Agreement, unless the context otherwise requires:

- (i) Any reference to a statutory provision shall include such provision as is from time to time modified or re-enacted or consolidated so far as such for modification or re-enactment or consolidation applied or is capable of applying to any transactions entered into hereunder;
- (ii) Reference to laws of Govt. of \_\_\_\_\_ (Name of STATE), law of India or Indian laws or regulations having force or law shall include the laws, acts, ordinances, rules, regulations, guidelines or bylaws which have the force of law in State of \_\_\_\_\_(Name of STATE);
- (iii) The headings are for convenience and reference only and shall not be used in and shall not affect, the construction or interpretation of this Agreement;
- (iv) Words importing Person or Parties shall include firms and corporations and any organization having legal capacity to sue and be sued in its name.
- (v) Words importing the singular shall include the plural and vice-versa where it requires.
- (vi) Any reference to day shall mean a reference to a calendar day;
- (vii) Any reference to month shall mean a reference to a calendar month;
- (viii) The Annexures of this Agreement form an integral part of this Agreement and will be in full force and effect as though they were expressly set out in the body of this Agreement;
- (ix) Any reference at any time to any agreement, deed, instrument or document of any description shall be construed as reference to that agreement, deed, instrument or other document as amended, varied, supplemented, modified or suspended at the time of such reference;
- (x) References to recitals, Articles, subarticles, or Schedules in this Agreement shall except where the context otherwise requires, be deemed to be references to recitals, Articles, subarticles and Schedules of or to this Agreement;
- (xi) Any Agreement, consent, approval, authorization, notice, communication information or report required under or pursuant to this Agreement from or by any Party shall be valid and effective only if it is in writing under the hands of duly authorized representative of such party, as the case may be, in this behalf and not otherwise;
- (xii) Any reference to any period commencing "from" a specified day or date and "until" a specified day or date shall include both such days and dates; provided that if the last day of any period computed under this Agreement is not a business day, then the period shall run until the end of next business day.

### **Measurements and Arithmetic Conventions**

All measurements and calculations shall be in metric system and calculations done in 2 decimals places, with the third digit of 5 or above rounded up and below 5 belong down except in Fee calculation that shall be rounded off to nearest Rupee Hundred (100).

### **Ambiguities within Agreement**

In case of ambiguities or discrepancies within this Agreement, the following shall apply:

- (i) Between two Articles or more of this Agreement, the provisions of specific Article relevant to the issue under the consideration shall prevail over those in other Articles;

- (ii) Between the Articles and the Annexures, the Articles shall prevail, save and except as expressly provided in the Articles or the Schedules;
- (iii) Between the written description on the Drawings and the Specification and Standards, the latter shall prevail;
- (iv) Between the written description on the Drawing and the specific written dimension, the latter shall prevail;
- (v) Between any value written in numerals and that in words, the later shall prevail, and
- (vi) Between the terms of expression of interest or tender document and this agreement, the latter shall prevail.

### Priority of Documents

The documents forming this Agreement are to be taken as mutually explanatory of one another. If there is an ambiguity or discrepancy in the documents, the Municipality shall issue any necessary **clarification or instruction to the "SERVICE PROVIDER/BIDDER" not later by Compliance Date, and the priority of the documents shall be as follows:**

- (i) This signed Agreement (including its Annexures), along-with any Addendums
- (ii) **Instructions to the "SERVICE PROVIDER/BIDDER" enclosed attached with this signed Agreement;** and
- (iii) All other documents enclosed attached with this signed Agreement.

### ARTICLE 2: TECHNICAL SPECIFICATIONS OF LED STREETLIGHTS

The Municipality has proposed to replace the existing streetlights with LED streetlights of XXW, XXW, XXW and XXW and the "SERVICE PROVIDER/BIDDER" has agreed to supply these lights in terms of this Agreement.

In addition to the other terms and conditions of this Agreement, it is mutually agreed by the Parties that the LED streetlights proposed to be supplied under this Agreement shall conform to the general specifications given in the Annexure-1 to this Agreement and the technical specifications as detailed thereunder:

S. No.	Street Light	Technical Specification
1	XXW	As per Annexure-2 to this Agreement
2	XXW	As per Annexure-3 to this Agreement
3	XXW	As per Annexure-4 to this Agreement
4	XXW	As per Annexure-5 to this Agreement
5	XXXW	As per Annexure-6 to this Agreement

### ARTICLE 3: SCOPE OF THE PROJECT

3.1 The Scope of the Project (the "Scope of the Project") shall mean and include during the Agreement Period "the Supply of xxx LED streetlights as detailed below."

At present the existing streetlights in the Municipality service area is in the following configuration in different Sectors:

Sr. No.	Sector	No. of Lights					Total
		70W	96W	150W	250W	400W	
1							
2							

3							
4							
	Total						

The "SERVICE PROVIDER/BIDDER" will supply LED streetlights of different wattages as indicated in the Table below against the existing Lights in different Sectors of \_\_\_\_\_:

Sr. No.	Sector	Wattage of existing Lights	Wattage of LED Lights proposed to replace with	Quantity
			Wattage	
1		70W	XXW	
2		96W	XXW	
3		150W	XXW	
4		250W	XXW	
5		400W	XXXW	
		Sector Total		
GRAND TOTAL				

**Summary of LED Lights proposed to be supplied is as under:**

S. No.	Wattage of LED Lights to be supplied	Quantity
1	XXW	
2	XXW	
3	XXW	
4	XXW	
5	XXXW	
	Total	

3.2 The "SERVICE PROVIDER/BIDDER" shall ensure supply of Energy-Efficient LED luminaries complete with all accessories, including mounting arrangement for street light. The LED streetlights must conform to the specifications given in Article: 2 of this Agreement. It is clarified herewith that notwithstanding what is stated in the Scope of Project, the responsibility rests with the "SERVICE PROVIDER/BIDDER" for installation, operation and maintenance of the LED streetlights supplied by the "SERVICE PROVIDER/BIDDER" during the Project Period and also extend the warranty to the supplied lights during the Agreement. The "SERVICE PROVIDER/BIDDER" shall start supply and installation of the LED Lights in accordance with the terms and conditions of this Agreement within ninety days from the date of compliance of Conditions Precedent as stated in Article 6 of this Agreement and complete the same in all respects within next nine months from that date. At the time of installation of lights if the "SERVICE PROVIDER/BIDDER" finds that the actual light points are different as compared to the number specified in Article 3.1 above and or the respective work orders, it will communicate the same to Municipality in writing. The Municipality on which the installation shall be deemed completed for all purposes under this Agreement. Accordingly the Municipality shall issue "Implementation Completion Certificate" in favor of the "SERVICE PROVIDER/BIDDER" forthwith.

3.3. The "SERVICE PROVIDER/BIDDER" shall maintain the installed LED Lights initially for a period of xx months from the date of issuing "Implementation Completion Certificate" to be issued by the Municipality in favor of the "SERVICE PROVIDER/BIDDER" on completion of installation of all the LED streetlights in respective sectors in terms of this Agreement. However, the "SERVICE PROVIDER/BIDDER" shall extend the warranty for the equipment under reference and maintain the same for another period of xx years.

3.4. The "SERVICE PROVIDER/BIDDER" shall ensure with the proposed LED Lights that the present lux level of approximately xx on main and dense traffic roads and lux level of about xx on colony and less traffic roads is maintained or lumen output of new lamps is equivalent to existing lamps.

3.5 The SERVICE PROVIDER/BIDDER after dismantling the existing fittings shall deposit the same on every day basis as per the directions of the Engineer in-charge of the particular sector of Municipality against the acknowledgment in writing of the same from Municipality. **The "SERVICE PROVIDER/BIDDER" shall have no responsibility** for safe keeping of the dismantled lights once they are offered for deposit with the Engineer in-charge.

#### **ARTICLE 4: DEFERRED PAYMENT**

##### **4.1 Deferred Payment**

- 4.1.1 Subject to and in accordance with the terms and conditions set forth in this Agreement, the Municipality hereby award the order for supplying xxx (number) LED streetlights of the types and specifications as detailed in Articles: 2 and 3 of this Agreement on deferred payment mode covering a period of xx (number) Months for payment of the consideration **amount to the "SERVICE PROVIDER/BIDDER" as per the schedules given in Annexures XX to YY** of this agreement.
- 4.1.2 Subject to and in accordance with the terms and conditions set forth in this Agreement the **"SERVICE PROVIDER/BIDDER" shall be responsible/entitle:**
- 4.1.2.1 To implement the Project as per the Scope of Work of the Project (more specifically detailed in Article 3) of this Agreement;
- 4.1.2.2 To fulfill its obligations under this Agreement, undertake activities either by itself or through subcontracting arrangements and to appoint contractors, subcontractors, agents, advisors and consultants without in any way relieving the SERVICE PROVIDER/BIDDER of its obligations as set out in this Agreement;
- 4.1.2.3 To exercise such other rights as the Municipality may determine as being necessary or desirable for the purposes incidental and necessary for implementing the Project.

The "SERVICE PROVIDER/BIDDER" acknowledges, accepts and confirms that the covenant contained herein is an essence of this Agreement.

##### **4.2 Actions in Support of the Deferred Payment**

- (i) The Parties shall recognize and undertake not to, in any manner, violate or cause breach of the terms of this Agreement.
- (ii) Municipality shall issue work order for the entire project. However, at the commencement of the Project, Project in-charge shall issue instructions in writing with respect of each sector separately giving the break-up of the consideration amount as shown in the table below.

Sr. No.	Sector	Total number of Lights	Total Consideration to be paid to "SERVICE PROVIDER/BIDDER" in xx months represents Cost of lights, cost of finance, cost of warranty, cost of maintenance and applicable taxes and duties (Rs)
---------	--------	------------------------	---

1			
2			

The Municipality shall complete payment of the total consideration in respect of the (above supplies in xx months as per the details shown in Annexures XX to YY of this Agreement. In each sector, the first payment shall be due not later than one month from the date of completing installation of the specified quantity of the lights. The Municipality shall issue "Implementation Completion Certificate" in favor of the "SERVICE PROVIDER/BIDDER" on completion of installation of all the LED streetlights in respective sectors in terms of this Agreement as shown-in the table above. The Municipality immediately thereafter shall deliver to the SERVICE PROVIDER/BIDDER a copy of its instructions to its bankers to remit the designated amount by 1st day of every month as per repayment schedules as shown in Annexures XX to YY of this Agreement to the "SERVICE PROVIDER/BIDDER" nominated bank amount.

- (iii) For the purpose of financing the Project, the "SERVICE PROVIDER/BIDDER" shall have the right to discount the individual bills duly acknowledged by the Municipality on installation of the LED streetlights with their bankers without any limitation.
- (iv) The Municipality shall extend lien during the period of this Agreement on its bank account or a bank guarantee totaling to Rs. xx crore (Rs. xx crores) towards security to the [Bank, Branch, City] that the "SERVICE PROVIDER/BIDDER" may opt for arranging the required funding for execution of this project.
- (v) The lien and the bank guarantee so extended shall be irrevocable and shall not be withdrawn by the Municipality till the total cost of project is repaid to the "SERVICE PROVIDER/BIDDER."
- (vi) The Municipality and the "SERVICE PROVIDER/BIDDER" undertakes not to terminate or repudiate this Agreement prior to its expiry otherwise, then in accordance with the provisions of this Agreement.

#### ARTICLE 5: IMPLEMENTATION PERIOD

- (i) The "Implementation Period" or "Time for Completion of Implementation" shall be a period of x(number) months from the date of compliance of Conditions
- (ii) Precedent as stated in Article-6 of this agreement, wherein the "SERVICE PROVIDER/BIDDER" shall be required to supply Energy-Efficient LED streetlights as detailed out in Articles 2 and 3 of this Agreement.
- (iii) The "SERVICE PROVIDER/BIDDER" guarantees that the time for completion of implementation of the Project shall be achieved in accordance with the provisions of this Agreement and not later than the implementation Period, as specified above.
- (iv) **Extension of Time:** The "SERVICE PROVIDER/BIDDER" may apply for an extension of the implementation Period under this agreement either before or after the end of implementation Period on account of any of the following causes: -
  - (a) A Variation;
  - (b) A Force Majeure event;
  - (c) A cause of delay giving an explicit and express entitlement to extension of time under any Articles in this Agreement,
  - (d) Any delay, impediment or prevention by the \_\_\_\_\_;
  - (e) Any delay caused by Competent Authorities.

Provided that the "SERVICE PROVIDER/BIDDER" shall at all times use its best endeavors to minimize any delay in the performance of its obligations under this Agreement, whatever may be such delay. If the "SERVICE PROVIDER/BIDDER" intends to apply for an extension of the Implementation Period, the "SERVICE PROVIDER/BIDDER" shall give notice to the Municipality of such intention as soon as possible and in any case within 30 (thirty) days of the start of the event giving rise to any such delay, together with any other notice required under this Agreement and relevant to such cause. Any such notice shall state the extent of the actual and anticipated delay and its anticipated effect on the Implementation Period, and shall specify the steps the "SERVICE PROVIDER/BIDDER" proposes to take to minimize such delay. The "SERVICE PROVIDER/BIDDER" shall keep such records as may be necessary to

substantiate any application, at a location acceptable to the Municipality or its representative, and such **other records as may reasonably be requested by the Municipality.** The "SERVICE PROVIDER/BIDDER" shall provide and permit the Municipality to inspect all such records.

**Provided that the "SERVICE PROVIDER/BIDDER" has complied with this Article, the Municipality shall proceed to determine either prospectively or retrospectively such adjustment as may be due, taking into account all relevant circumstances. The Municipality shall notify the "SERVICE PROVIDER/ BIDDER" accordingly.** When determining each extension of time, the Municipality shall review its previous determinations and may revise, but shall not decrease, the extension, and provided that the extension of time is not a consequence of any negligence, default or breach of this Agreement by the "SERVICE PROVIDER/BIDDER" or those for whom it is responsible.

**However, the "SERVICE PROVIDER/BIDDER" shall not be entitled to an extension of the Implementation Period, to the extent that the delay in respect of which the extension of time is requested is attributable to any negligence, default or breach his Agreement by the "SERVICE PROVIDER/BIDDER" or those for whom it is responsible, as determined by the STATE GOVERNMENT.**

## **ARTICLE 6: CONDITIONS PRECEDENT**

Subject to the express terms to the contrary, limited aspects of the Implementation Period (when commenced) and any legitimate rights arising in law, the rights and obligations under this Agreement shall take effect only upon fulfillment of all the Conditions Precedent specified below in this Article 6 on or before the expiry of a period of 30(thirty) days from the Compliance Date. However, the Municipality may at any time at its sole discretion and in writing, waive fully or partially any of the Conditions Precedent of the "SERVICE PROVIDER/BIDDER."

### 6.1 Conditions Precedent for the Municipality

The Municipality shall:

- i. Provide an undertaking that all of the Representations and Warranties of the Municipality set forth in this Agreement are true and correct as on date this Agreement are as on the Compliance Date and thereafter;
- ii. Issue government orders or gazette notifications as necessary for implementing the Project.
- iii. Issue necessary documents in support of lien on its bank account or bank guarantee to the maximum extent of Rs. xx Crore (Rs. xx Crore) detailed in Article: 4.2 immediately after signing this agreement.
- iv. **Provide the "SERVICE PROVIDER/BIDDER" copies** (certified as true by the designated of the Municipality) of all resolutions adopted by the Municipality for execution, delivery and performance of this Agreement.

### **6.2 Conditions Precedent for the "SERVICE PROVIDER/BIDDER":**

The "SERVICE PROVIDER/BIDDER" shall:

- i. **Provide an undertaking that all of the Representations and Warranties of the "SERVICE PROVIDER/BIDDER" set forth in this Agreement are true and correct as on date of this Agreement and as on the Compliance Date and thereafter;**
- ii. Provide the Municipality copies (certified as true copies by an authorized officer of the "SERVICE PROVIDER/BIDDER") of its constitutional documents.
- iii. **Provide the Municipality copies (certified as true by the Director of the "SERVICE PROVIDER/ BIDDER") of all resolutions adopted by the Board of Directors of the "SERVICE PROVIDER/ BIDDER" authorizing the execution, delivery, and performance of this Agreement by the "SERVICE PROVIDER/BIDDER";**
- iv. **Provide that upon request in writing by the "SERVICE PROVIDER/BIDDER," the Municipality may, at its sole discretion and in writing, waive fully or partially any or all the Conditions Precedent set forth in this Article.**

### **6.3 Obligations to satisfy Condition Precedents**

- (i) Each Party hereto shall use all reasonable endeavors to procure the satisfaction in full of its respective Conditions Precedent set out above within 30 (thirty) days from Compliance Date.
- (ii) Each Party shall bear its respective costs and expenses of satisfying Conditions Precedents unless otherwise expressly provided.

#### 6.4 Nonfulfillment of Conditions Precedent

- i. In the event that any of the Conditions Precedents relating to the "SERVICE PROVIDER/BIDDER" have not been fulfilled within 30(thirty) days from the Compliance Date and also, the Municipality has not waived them fully or partially, then necessary action shall be initiated to cure the defects by mutual agreement of the Parties to this Agreement.
- ii. In the event the "SERVICE PROVIDER/BIDDER" opts to terminate or dishonor this Agreement because of nonfulfillment of Conditions Precedent by the Municipality or for any other reason what so ever not specified in this agreement, the Municipality shall be liable to compensate the "SERVICE PROVIDER/BIDDER" all the costs/ expenses incurred in relation to the project from the Compliance Date.

## ARTICLE 7: COMMERCIAL CONSIDERATION

### 7.1 Commercial Consideration to the "SERVICE PROVIDER/BIDDER"

- i. The calculations of the deferred Payment shall be as per provisions laid down in the Annexures XX to YY of this Agreement.
- ii. The Municipality shall complete payment of the total consideration in respect of the above supplies in xx months as per the details shown in Annexures XX to YY of this Agreement. In each sector, the first payment shall be due not later than one month from the date of completing installation of the specified quantity of the Street LED lights.
- iii. However, the \_\_\_\_\_ is at liberty to pay over and above the monthly liability at any time if it desires to reduce its liability without any cost to the "SERVICE PROVIDER/BIDDER."
- iv. The "SERVICE PROVIDER/BIDDER" shall be entitled to get the amounts credited as per point [b] above on respective due dates. In the event if any credit is not received within 7 days from the respective due date, the "Municipality" shall compensate the "SERVICE PROVIDER/BIDDER" with the interest at the rate of 16% till the dues are cleared.

### 7.2 Performance Assurance

- i. The "SERVICE PROVIDER/BIDDER" shall ensure that for the entire Agreement Period the LED streetlights supplied shall perform to the agreed standards as per LM-80 and L-70 standards as detailed in Annexures 7 and 8 to this Agreement.
- ii. The "SERVICE PROVIDER/BIDDER" shall extend warranty to the products supplied under this agreement throughout the Agreement Period (that is, xx months of BOT period) covering any manufacturing defects. The warranty shall be limited to only manufacturing defects. Further the warranty shall also be not applicable for any damage or malfunctioning of LED streetlights on account of lightning strike, fire or any kind of Act of God beyond the control of either of the Parties including adverse weather conditions, earth quakes, rains, tempest, whirlwind, landslides, storms, volcanic eruptions, fire or any calamities, riots, high voltage, unauthorized handling, accidents and thefts.
- iii. In the event of any dispute about the performance/efficiency of any luminary supplied under this Agreement such luminary shall be tested on calibrated watt meter for verification of consumption of power in Watts. If the luminary fails to the agreed specification the "SERVICE PROVIDER/BIDDER" shall rectify or replace it in terms of warranty at its own cost throughout the Agreement Period.
- iv. It is mutually agreed by the Parties that the "SERVICE PROVIDER/BIDDER" shall have no responsibility for demonstrating power savings in the form of periodic power bills and the SERVICE PROVIDER/BIDDER's responsibility is only limited to the scope specified in clause (c) above.
- v. The Performance Assurance of the "SERVICE PROVIDER/BIDDER" shall be limited to only warranty during the Agreement Period.

- vi. The "SERVICE PROVIDER/BIDDER" shall handover to Municipality up to 1% of the total quantity of lights in each sector and in respect of each wattage immediately after completion of supplies to that sector so as to use these lights as possible replacements for any defects that may arise. The "SERVICE PROVIDER/BIDDER" shall be responsible to collect defective lights from the store of "Municipality" at its own cost and arrange repair/replacements in terms of warranty and return the same to the store of the Municipality within a period of 8 to 10 days from collecting them.

## ARTICLE 8: OBLIGATIONS OF THE "MUNICIPALITY" DURING AGREEMENT PERIOD

### 8.1 General Obligations

It shall be the obligation of Municipality to ensure the following are made available or executed:

- i. The Municipality shall assist in getting permissions and exemptions as may be required under laws relating to it and regulating the Project as applicable in the State of \_\_\_\_\_ (Name of STATE). However the responsibility lies with the SERVICE PROVIDER/BIDDER of getting necessary permissions and exemptions.
- ii. The shall ensure that from the date of this Agreement and till the completion of the Project, **the "SERVICE PROVIDER/BIDDER" has access to the Project Facilities for the purpose of carrying out the "SERVICE PROVIDER/BIDDER'S" obligations under this Agreement.**
- iii. The Municipality shall receive the supplied LED Lights as per the terms of this Agreement and ensure their safe storage in a closed enclosure at their own cost till their installation.
- iv. The Municipality shall promptly receive the existing lights after their dismantling from the **"SERVICE PROVIDER/BIDDER" on daily basis and the "SERVICE PROVIDER/BIDDER" shall have no responsibility for their safe keeping once they are dismantled and offered for deposit with Municipality.**
- v. The Municipality shall be responsible for any misplacement, thefts and damages of the LED Lights supplied from the date of the supply and till the completion of this Agreement. The Municipality shall pay the cost of the particular **fitting to the "SERVICE PROVIDER/BIDDER"** in the event of any misplacements of, theft of, or damage to the supplied lights.

## ARTICLE 10: OBLIGATIONS OF THE "SERVICE PROVIDER/BIDDER" DURING IMPLEMENTATION PERIOD

### General Obligations

The "SERVICE PROVIDER/BIDDER" shall observe, undertake, comply with and perform, in addition to and not in derogation of its obligations elsewhere set out in this Agreement, the following:

- i. Carry out the works strictly in accordance with the provisions and the Annexures of this Agreement, and all works not mentioned in this Agreement but which may be inferred to be necessary for safe, reliable and efficient the Implementation and operation of the Project;
- ii. Undertake to achieve project completion no later than xx (xx) months subject to extension of time granted under Article 5 (c) of this Agreement from the date of compliance of Conditions Precedent, provided that the SERVICE PROVIDER/BIDDER shall not be in breach of this Article, if any nonfulfillment or the delay in fulfillment of its obligation are caused by (i) the occurrence of an event of Force Majeure or (ii) Municipality default or any other act or omission of the Municipality in contravention of its obligations under this Agreement, and in the event of any delay **in installation of streetlights, the "Municipality" shall be entitled to penalize SERVICE PROVIDER/BIDDER Re. 1 per day per light for the delayed days. Also in case the fittings do not work then the Municipality shall be entitled to penalize SERVICE PROVIDER/BIDDER Rs. 5 per day per light for the delayed days beyond 72 hours of receiving complaint.**
- iii. **The "SERVICE PROVIDER/BIDDER" shall ensure supply of Energy-Efficient LED street lights as per the specifications mentioned in this Agreement and related Annexures by maintaining**

- sound manufacturing, testing and R&D facility. The "SERVICE PROVIDER/BIDDER" shall provide the test reports of the lights and LM-79 certificates.
- iv. The "SERVICE PROVIDER/BIDDER" shall plan, organize and execute the supplies so that the Agreement is executed without any friction.
  - v. **Subcontracting:** The "SERVICE PROVIDER/BIDDER" shall be entitled to subcontract tasks relating to its obligations and responsibilities under this Agreement, including but not limited to tasks relating to implementation of the Project. However, the "SERVICE PROVIDER/BIDDER" shall be sole and primary person responsible to the Municipality for the observance of all the provisions of this Agreement. The "SERVICE PROVIDER/ BIDDER" shall be responsible for the acts or defaults of any of its subcontractor, its agents or employees, as if they were the acts or defaults of the "SERVICE PROVIDER/BIDDER," its agents or employees. Any subcontracting shall not relieve the "SERVICE PROVIDER/BIDDER" of its obligations and liabilities under this Agreement.
  - vi. To duly supervise, monitor, and control the activities of Contractors, subcontractors, their employees and agents under their respective Project Agreement as may be necessary.
  - vii. Not to permit any contractor, subcontractors or other person, claiming through or under the "SERVICE PROVIDER/BIDDER," to create or place any security interest over all or any part of Project Facility or on any rights of the "SERVICE PROVIDER/BIDDER" herein or under this Agreement, save and except as expressly permitted in this Agreement.
  - viii. Shall within the time permitted by the Municipality, make good all the defects and ensure that the items or materials complies with this Agreement.
  - ix. Shall ensure that if any designated devices, materials or any process covered by letters of "Patents" or "Copyrights," the right for such use shall be secured by the "SERVICEPROVIDER/BIDDER" by suitable legal arrangements and agreements with the Patents owner. A copy of the agreement, if any, shall be submitted to the Municipality. Municipality shall not be responsible in any way, in case of any violation of patents and copy rights.
  - x. The "SERVICE PROVIDER/BIDDER" shall acknowledge and recognize that time is of the essence in this Agreement and that the performance of its obligations shall be construed accordingly.
  - xi. The "SERVICE PROVIDER/BIDDER" shall not be authorized to incur any expenditure on behalf of the Municipality, or to enter into any commitment as agent of the Municipality, unless specifically and explicitly authorized by the Municipality under the terms of agreement. The "SERVICE PROVIDER/BIDDER" shall not amend, terminate, modify or supplement any agreement on behalf of or in the name of the Municipality.
  - xii. The "SERVICE PROVIDER/BIDDER" undertakes to install the fittings at his own cost and risk with no extra burden on Municipality for installation.

## ARTICLE 11: OBLIGATIONS OF PARTIES

### Each Party shall:

- (i) Comply with and perform its respective obligations under this Agreement and shall work and cooperate in good faith with the with respect to all the obligations and rights hereunder of the other Party.
- (ii) Carry out their respective obligations during the Implementation Period.

## ARTICLE 12: Representations and Warranties

### 12.1 Representations and Warranties of the Municipality

The Municipality represents and warrants to the "SERVICE PROVIDER/BIDDER" that:

- i. The Municipality has full power and authority to execute, deliver and perform its obligations under this Agreement and to carry out the transactions contemplated hereby;
- ii. The Municipality have taken all necessary action to authorize the execution, delivery and performance of this Agreement;
- iii. This Agreement constitutes a legal, valid and binding obligation enforceable against the Authority in accordance with the terms hereof;

- iv. The Authority is subject to civil and commercial laws of India with respect to this Agreement and hereby expressly and irrevocably waives any sovereign immunity in any jurisdiction in regard to matters set forth in this Agreement.
- v. All information provided by the Municipality in connection with the Project is true and accurate in all material respects to the best of its knowledge; and
- vi. The Municipality has the financial standing and capacity to perform obligations under this Agreement.

## 12.2 Representations and Warranties of the "SERVICE PROVIDER/BIDDER"

The "SERVICE PROVIDER/BIDDER" represents and warrants to the Municipality that:

- i. It is duly organized, validly existing and in good standing under the laws of the jurisdiction of its incorporation;
- ii. It has full power and authority to execute, deliver and perform its obligations under this Agreement and to carry out the transactions contemplated hereby;
- iii. It has taken all necessary corporate and other action under Applicable Laws and its constitutional documents to authorize the execution, delivery, and performance of this Agreement;
- iv. It has the financial standing and capacity to undertake the Project;
- v. This Agreement constitutes its legal, valid and binding obligation enforceable against it in accordance with the terms hereof;
- vi. It is subject to civil and commercial laws of India with respect to this Agreement and it hereby expressly and irrevocably waives any immunity in any jurisdiction in respect thereof;
- vii. All the information furnished in this Agreement /Bid /Proposal is, and shall be, true and correct as on the Proposal Acceptance Date. If in case any false or misleading information, as furnished by the "SERVICE PROVIDER/BIDDER," is found at a later stage after the signing of this Agreement, it shall entitle the Municipality to terminate the said signed Agreement between the Parties.
- viii. The "SERVICE PROVIDER/BIDDER" has complied with all Applicable Laws and has not been subject to any fines, penalties, injunctive relief or any other civil or criminal liabilities which in the aggregate have or may have Material Adverse Effect on its financial condition or its ability to perform its obligations and duties under this Agreement.

## 12.3 Obligation to Notify Change

In the event that any of the representations or warranties made/ given by the "SERVICE PROVIDER/BIDDER" ceases to be true or stands changed, it shall promptly notify Municipality of the same.

## ARTICLE 13: TERMINATION FOR DEFAULT

### 13.1 The "MUNICIPALITY" Events of Default

Each of the following events or circumstances, to the extent not caused by a default of the "SERVICE PROVIDER/BIDDER" or Force Majeure, and it not cured within the Cure Period, which shall be 30 (thirty) days (unless provided otherwise in this Agreement), from the date of notice of default (the "Default Notice") from the "SERVICE PROVIDER/BIDDER," shall be considered for the purpose of this Agreement as events of default of the Municipality.

- i. The Municipality is in breach of its obligations under this Agreement, which has a Material Adverse Effect upon the "SERVICE PROVIDER/BIDDER" or the Project and this breach is not cured within a Cure Period of 30 days from the date of Default Notice.
- ii. The Municipality is in breach of any representation or warranty made under this Agreement or it repudiates this Agreement.
- iii. Govt. of \_\_\_\_\_ (Name of STATE) or any Competent Authority has by an act of commission or omission created a circumstance that has a Material Adverse Effect on the "SERVICE

PROVIDER/BIDDER” and the Municipality has failed to compensate the “SERVICE PROVIDER/BIDDER” for the same through an adjustment.

- v. The Municipality fails to pay the SERVICE PROVIDER/BIDDER the consideration as applicable.

### **13.2 Termination by the “SERVICE PROVIDER/BIDDER”**

Without prejudice to any right or remedy, which the “SERVICE PROVIDER/BIDDER” may have under this Agreement, upon occurrence of Default or Event of Default by the “Municipality,” the “SERVICE PROVIDER/BIDDER” shall be entitled to issue a Termination Notice to the “Municipality.” The Termination Notice shall grant the “Municipality” a further period of 30 (thirty) days (the “Termination Period”) to make a representation, and if, during the Termination Period the “Municipality” takes suitable steps to remedy the situation, the “SERVICE PROVIDER/BIDDER” shall be entitled to withdraw the Termination Notice. If the Termination Notice is not withdrawn within the Termination Period, this Agreement will automatically terminate on the expiry the Termination Period.

### **13.3 “SERVICE PROVIDER/BIDDER” Event of Default**

Each of the following events or circumstances, to the extent not caused by default of the “Municipality” or Force Majeure, and if not cured within the “Cure Period” which shall be 30 (thirty) days from the date of notice of default (the “Default Notice”) from the “Municipality,” shall be considered for the purpose of this Agreement as Events of Default of the “SERVICE PROVIDER/BIDDER”:

- i. The “SERVICE PROVIDER/BIDDER” is in breach of its obligations under this Agreement, which has a Material Adverse Effect upon the Municipality or the Project.
- ii. The “SERVICE PROVIDER/BIDDER” is in breach of any representation or warranty made under this Agreement or it repudiates this Agreement.
- iii. The “SERVICE PROVIDER/BIDDER” abandons the Project or any of its material obligations as provided under this Agreement.

### **13.4 Termination by the Municipality**

Without prejudice to any other right or remedies which the Municipality may have under be entitled to terminate this Agreement by following the procedure set forth under this Agreement, upon occurrence of a “SERVICE PROVIDER/BIDDER” Event of Default, the Municipality shall be entitled to terminate this Agreement by following the procedure set forth hereinafter:

- i. The Municipality shall be entitled to issue a Termination Notice to the “SERVICE PROVIDER/BIDDER.” The Termination Notice shall grant the “SERVICE PROVIDER/BIDDER” 30 (thirty) days (the “Termination Period”) to make a representation, and if, during the Termination Period the “SERVICE PROVIDER/BIDDER” takes suitable steps to remedy the default situation, the “MUNICIPALITY” shall be entitled to withdraw the Termination Notice.
- ii. If the “SERVICE PROVIDER/BIDDER” fails cure the defaults within the Termination Period this Agreement stands terminated by the Municipality.
- iii. In case of termination, either party shall issue notice in writing. The notice given on the address given in the title clause of this agreement will be considered as a valid notice.

## **ARTICLE 14: CONSEQUENCES OF TERMINATION**

Upon termination of this Agreement for any reason, the terms of specified in this Agreement shall cease to exist and are not enforceable.

### **14.1 Termination Payment for Termination by “SERVICE PROVIDER/BIDDER”**

- i. Upon Termination by the “SERVICE PROVIDER/BIDDER” on account of the Municipality Default under Articles 13.1 and 13.2, the “SERVICE PROVIDER/BIDDER” shall be entitled to receive from Municipality by the way of Termination Payment a sum equal to the consideration of the Project as specified in Article 4 of this Agreement minus the amounts paid till termination of the Agreement minus the interest not applicable for the balance period of the Agreement after termination.
- ii. On account of the Municipality default leading to premature termination of this Agreement, the Municipality shall pay compensation to the “SERVICE PROVIDER/BIDDER” at the rate of

- 10% of the consideration of the project as specified in Article 4 of this Agreement, in addition to the amount payable in terms of clause 14.1 (a) above.
- iii. **Payments due to the "SERVICE PROVIDER/BIDDER" as calculated under** Article 14.1 (a) and (b) shall be made within 30 (thirty days) days of termination of the Agreement pursuant to Article 13.1 and 13.2.
- iv. In case of termination of agreement, either party will have no claims against each other except stated in clause no 14.1 (a) and (b).

#### 14.2 Termination Payment for Termination by Municipality

- i. **Upon Termination by the "MUNICIPALITY" on account of default by the "SERVICE PROVIDER/BIDDER" during period of this Agreement, in accordance with the provisions of Articles 13.3 and 13.4, the "SERVICE PROVIDER/BIDDER" shall be entitled to receive from the Municipality by the way of Termination Payment a sum equal to 90% of the consideration of the project as specified in Article-4 of this Agreement minus the amounts paid till termination of the Agreement minus the interest not applicable for the balance period of the Agreement after termination.**
- ii. **However, if the Termination by the Municipality on account of the default by the "SERVICE PROVIDER/BIDDER" before supplies are effected in terms of this Agreement, then the "SERVICE PROVIDER/BIDDER" shall not be entitled for any Termination Payments.**

#### 14.3 Other rights and obligations upon Termination

- i. **Upon Termination of this Agreement and payment of Termination Payment to the "SERVICE PROVIDER/BIDDER" as applicable in full, the Municipality shall:-**
  - a. Take control of the Project forthwith;
  - b. Take control of all Energy-Efficient LED streetlights supplied under this Agreement.
  - c. **Shall return to the "SERVICE PROVIDER/BIDDER" the 1% of additional LED Lights provided as possible replacements.**
- ii. **Upon Termination of this Agreement it shall be the responsibility of the "SERVICE PROVIDER/BIDDER" to co-operate with the Municipality and comply with all reasonable requests thereof including the execution of any documents and other actions, provided the Municipality bears any reasonable Costs incurred by the "SERVICE PROVIDER/BIDDER" relating thereto.**

## ARTICLE 15: FORCE MAJEURE

### 15.1. Force Majeure Event

In this Agreement "Force Majeure" means an event occurrence in India of any or all of the Non-Political Force Majeure Event. Indirect Political Force Majeure Event and Political Force Majeure Event described in Articles 15.2, 15.3, and 14.4 respectively hereinafter which prevents the Party claiming Force Majeure (the "Affected Party") from performing its obligations under this Agreement and which act or event:-

- i. Is beyond the reasonable control of and not arising out of the fault or negligence of the Affected Party or the failure of such Party to perform its obligations hereunder;
- ii. The Affected Party has been unable to prevent by the exercise of due diligence and reasonable efforts, skill and care and
- iii. Has a Materially Adverse Effect on the Project.

### 15.2 Non-Political Force Majeure Events

For the purposes of Article 15.1, Non-Political Force Majeure Events shall mean one or more of the following acts or events:

- i. Acts of God or events beyond the reasonable control of the Affected Party which could not reasonably have been expected to occur, extreme adverse, weather or environmental conditions, lightning, earthquakes, heavy rains, cyclones, tempest, whirlwind, landslides, storms, floods, volcanic eruptions or fire (to the extent originating from a source external to the Facility or not designed for in Implementation Works);

- ii. Radioactive contamination or ionizing radiation;
- iii. Strikes or boycotts (other than those involving the Contractors, or their respective employees/representatives or to any act or omission of any of them) interrupting supplies and services to the Project for a continuous period exceeding 6(Six) months from the Compliance Date, and not being an Indirect Political Event set forth in Article 14.3;
- iv. Any judgment or order of any court of competent jurisdiction or statutory authority in India **made against the "SERVICE PROVIDER/BIDDER" in any proceedings for the reasons other than failure of the "SERVICE PROVIDER/BIDDER" to comply with any Applicable Law or** Clearances or on account of breach thereof, or of contract, or enforcement of this Agreement or exercise of any of its rights under this Agreement by the \_\_\_\_\_.

### 15.3 Indirect Political Force Majeure Event

For the purposes of Article 15.1, Indirect Political Force Majeure Events mean one or more of the following acts or events by or on account of the \_\_\_\_\_, Govt. of \_\_\_\_\_ (Name of STATE), Gol or any other Competent Authority:

- i. An act of war (whether declared or undeclared), invasion, armed conflict or act of foreign enemy, unexpected call up of armed forces, blockade, embargo, rebellion, riot, religious strife, bombs or civil commotion, sabotage, terrorism which prevents normal operations of the **"SERVICE PROVIDER/BIDDER" for a continuous period exceeding 6 (six) months from the Compliance Date.**
- ii. Industry wide or state wide or India wide strikes or industrial action for a continuous period exceeding 6 (six) months from the Compliance Date.

### 15.4 Political Force Majeure Event

For the purposes of Article 14.1, Political Force Majeure Events shall mean one or more of the following acts or events by or on account of the \_\_\_\_\_, Govt. of \_\_\_\_\_ (Name of STATE), Gol or any other Competent Authority:

- i. Appropriation or compulsory confiscation, by any Competent Authority any Project Assets or **rights of the "SERVICE PROVIDER/BIDDER" or of the Contractors; or**
- ii. Any unlawful or unauthorized or without jurisdiction, revocation of, refusal to renew or grant **without valid cause any consent or approval required by the "SERVICE PROVIDER/BIDDER"** or any of the Contractors to perform their respective obligations under this Agreement (other than a consent, the obtaining of which is a condition precedent) provided that such delay, modification, denial, refusal or revocation did not result from the **"SERVICE PROVIDER/BIDDER'S" or any contractor's inability or failure to comply with any condition** relating to the grant, maintenance or renewal of such consents or permits.

### 15.5 Exceptions Applicable to the "SERVICE PROVIDER/BIDDER"

The "SERVICE PROVIDER/BIDDER" shall not have the right to consider any of the following circumstances to be an event of Force Majeure that would suspend the performance or excuse the nonperformance of its obligations under this Agreement other than the circumstances resulting from an event of Force Majeure: -

- i. **Delay in performance by the "SERVICE PROVIDER/BIDDER," Subcontractor(s), agents and employees of the "SERVICE PROVIDER/BIDDER"; or**
- ii. Breakdown or ordinary wear and tear of materials, equipment machinery or parts relating to the Project.

### 15.6 Exceptions Applicable to the \_\_\_\_\_

The \_\_\_\_\_ Authority shall not have the right to consider any of the following circumstances to be an event of Force Majeure that would suspend the performance or excuse the nonperformance of its obligations under this Agreement:

- i. The appropriation, confiscation, nationalization or requisition of the h Project, Project Assets by the \_\_\_\_\_:
- ii. The imposition of any blockade, embargo, import restrictions, rationing or allocation by the \_\_\_\_\_ or any Competent Authority; or
- iii. Change of Governments or administrators of \_\_\_\_\_.

### **15.7 Effect of Force Majeure after Compliance Date**

Upon occurrence of any Force Majeure Event after the Compliance Date, the following shall apply:

- i. There shall be no Termination of this Agreement except as provided in Articles 15.9, 15.10 and 15.11.
- ii. Where the Force Majeure Event occurs after the Compliance Date the critical time limits set forth in this Agreement shall be extended by the period for which such Force Majeure Event shall subsist;
- iii. All cost arising out or concerning such Force Majeure Event shall be borne in accordance with provisions of Article 15.8.

### **15.8 Allocation of costs during the subsistence of Force Majeure**

Upon occurrence of a Force Majeure Event after Compliance Date, the cost arising out of such event shall be allocated as follows:

- i. When the Force Majeure Event is a Non-Political Event, the Parties shall bear their respective costs and neither Party shall be required to pay to the other Party any cost arising out of any such Force Majeure Event;
- ii. Where the Force Majeure Event is an Indirect Political Event, the costs attributable to such Force Majeure Event and directly relating to the Project (the Force Majeure Costs), shall be **reimbursed by the \_\_\_\_\_ to the "SERVICE PROVIDER/BIDDER" within 30 (thirty) days from the date of receipt of SERVICE PROVIDER/BIDDER's claim** therefore;
- iii. Where the Force Majeure Event is a Political Event, the Force Majeure Costs to the extent actually incurred and duly certified by the Statutory Auditors shall be reimbursed by the \_\_\_\_\_ **to the "SERVICE PROVIDER/BIDDER" in one lump sum not later than 30 (thirty) days after the end of the Force Majeure Event and receipt of notice by the "MUNICIPALITY"** to that effect.

### **15.9 Termination Notice**

If the Force Majeure Event subsists for a period of 270 (two hundred seventy days or more within a continuous period of 365 (three hundred sixty five) days either Party may in its sole discretion terminate this Agreement by giving 30 (thirty) days Termination Notice in writing to the other Party without being liable any manner whatsoever, save and except as per the provisions of in Article 15.

### **15.10 Termination Payments for Force Majeure Events**

Upon Termination of this Agreement pursuant to Article 15.9, the Termination Payment to the "SERVICE PROVIDER/BIDDER" shall be made in accordance with the following:

- i. If the Termination is on account of Non-Political Event, the "SERVICE PROVIDER/BIDDER" shall be entitled to receive from the \_\_\_\_\_ by way of Termination Payment an amount equal to 90% (ninety percent) of the consideration of the project as specified in Article-4 of this Agreement minus the amounts paid till termination of the Agreement minus the interest not applicable for the balance period of the Agreement after termination.
- ii. If the Termination of this Agreement is on account of an Indirect Political Event, the "SERVICE PROVIDER/BIDDER" shall be entitled to receive from the "MUNICIPALITY" by the way of Termination Payment an amount equal to the consideration of the project as specified in Article

4 of this Agreement minus the interest not applicable for the balance period of Agreement after termination.

- iii. **If the Termination of this Agreement is on account of a Political Event, the “SERVICE PROVIDER/BIDDER” shall be entitled to receive from the \_\_\_\_\_ Authority by the way of Termination Payment an amount equal to the consideration of the project as specified in Article 4 of this Agreement minus the amounts paid till termination of the Agreement minus the interest not applicable for the balance period of the Agreement after termination.**

### **15.11. Termination Payments**

The Termination Payments pursuant to the Article 15.10 shall become due and payable to the “SERVICE PROVIDER/BIDDER” by the \_\_\_\_\_ in one lump sum not later than 30 (thirty) days after the end of the Force Majeure Event and notice of the \_\_\_\_\_ to that effect.

### 15.12 Dispute Resolution

In the event that the Parties are unable to agree in good faith about the occurrence or existence of a Force Majeure Event, such dispute shall be finally settled in accordance with the Dispute Resolution procedure as under Article 16 provided however that the burden of proof as to the occurrence or existence such Force Majeure event shall be upon Party claiming relief and/or excuse the account of such Force Majeure Event.

### **15.13 Duty to Report**

The Affected Party shall discharge the following obligations in relation to reporting the occurrence of a Force Majeure Event to the other Party:

- i. The Affected Party shall not claim any relief for or in respect of a Force Majeure Event unless it shall have notified the other party in writing of the occurrence of the Force Majeure Event as soon as reasonably practicable, and in any event within 15 (fifteen) days after the Affected Party knew or ought reasonably to have known of its occurrence and the probable Material Adverse Effect that the Force Majeure Event is likely to have occurred on the performance of its obligations under this Agreement.
- ii. Any notice pursuant to this Article 15.13 shall include full particulars of:
  - a. The nature and extent of each Force Majeure Event which is the, subject of any claim for relief under this Article with evidence in support thereof;
  - b. The estimated duration and effect or probable effects which such Force Majeure Event **is having or will have on the Affected Party’s performance of its obligations** under this Agreement;
  - c. The measure which the Affected Party is taking or proposes to take to alleviate the impact of such Force Majeure Event; and
  - d. **Any other information relevant to the Affected Party’s Claim.**
- iii. For so long as the Affected Party continues to claim to be affected by such Force Majeure Event, it shall provide the other Party with regular (and not less than weekly) written reports containing information as required by this Article, and such other information as the other Party may reasonably request the Affected Party to provide.

### **15.14 Excuse from performance of obligations**

If the affected Party is wholly or partially unable to perform its obligations under this Agreement because of Force Majeure Event, it shall be excused from performance of such of its obligations to the extent it is unable to perform on account of such Force Majeure Event provided that:

- i. The suspension of performance shall be no more than scope and duration then is reasonably required by the Force Majeure Event;
- ii. The Affected Party shall make all reasonable efforts to mitigate or limit damage to the other Party arising out of or as a result of the existence or occurrence of such Force Majeure Event and to cure the same with due diligence; and

- iii. When the Affected Party is able to resume performance of its obligations under this Agreement, it shall give to the other Party written notice to that effect and shall promptly resume performance of its obligations hereunder;

## ARTICLE 16: DISPUTE RESOLUTION

### 16.1 Dispute Resolution

Any dispute, difference or controversy of whatever nature regarding the validity, interpretation, implementation or the rights and obligations arising out of, or in relation to, or howsoever arising under or in relation to this Agreement between the Parties, and so notified by either Party to the other Party (the "Dispute") shall subject to the dispute resolution procedure set out in this Article. It is specially clarified here that in case of any ambiguity regarding the works, the practices existing at the time of submission of the proposal as per Good Industry Practice would prevail.

### 16.2 Direct discussion between Parties

The Parties agree that any Dispute that may arise between them shall be first submitted for direct discussion between the Parties. For this purpose, the notice of Dispute (the "Notice of Dispute") sent by one Party to the other Party under Article 16.1 shall be considered as invitation for direct discussion, and it should specify a reasonable time and venue for the conducting of negotiation proceedings. In addition, the Notice of Dispute shall specify the basis of the Dispute and the amount claimed. In the direct discussion proceedings, each Party shall be represented by their representatives/officials or employees with sufficient knowledge and authority over the subject matter of the Dispute in order to have a meaningful discussion. At the discussion proceedings, the Party that has given the Notice of Dispute shall present an offer of settlement, which may form the starting point of discussions between the two Parties during the discussion proceedings.

The direct discussion meeting as stated above will be held at the Office of the Project In-charge, (Name of Municipal Corporation). Minutes of the proceedings of this meeting shall be recorded by the Project in charge \_\_\_\_\_ (Name of Municipal Corporation).

### 16.3 Arbitration or Adjudication

- i. In the event that the parties are unable to resolve the Dispute through Direct Discussion under Article 16.2, the Parties shall submit the Dispute for arbitration in accordance with the Arbitration and Conciliation Act, 1996. There shall board of 3 (three) arbitrators of whom **1 (one) shall be appointed by the Municipality, 1 (one) shall be appointed by the "SERVICE PROVIDER/BIDDER" and the third appointed by the 2 (two) arbitrators appointed as aforesaid.**
- ii. The arbitration proceedings shall be conducted in the English language only.
- iii. The cost incurred on the process of arbitration including inter alia the fees of the arbitral tribunal and the cost of the proceedings shall be borne by the in equal proportions. Each Party shall bear its own legal fees incurred as of any Dispute under this Article.
- iv. The arbitration proceeding shall be conducted in \_\_\_\_\_ (Name of STATE).
- v. If any dispute goes to the court of law, the jurisdiction of the court shall be the District Court, City.

### 16.4 Performance during Dispute

Performance of this Agreement shall continue during the settlement of any Dispute under this Article. The provisions for dispute settlement shall be binding upon the successors, assigns and any trustee or receiver or either the Municipality or the "SERVICE PROVIDER/BIDDER".

## ARTICLE 17: Confidentiality

Neither of the Parties shall, at any time, before the expiry or termination of this Agreement, without the consent of the other Party, divulge or suffer or permit its officers, employees, or agents to divulge to any person (other than to any of their respective officers or employees who require the same to enable the properly to carry out their duties), any information relating to the negotiations concerning

the operations, contracts, commercial or financial arrangements of affairs of the other Party or any proprietary information of the other Party.

### **ARTICLE 18: Carbon Credits**

Because of the Energy Efficiency Measures, the Project may qualify for registering with UNFCCC (United Nations Framework Convention on Climate Change) under CDM (Clean Development Mechanism). The Municipality shall have the right to submit the Project for approval and certification under the Clean Development Mechanism (CDM) Regime of the Kyoto Protocol and to sell the Certified Emission Reductions generated.

The Municipality shall have exclusive rights over the revenues accruing from such CDM transactions and the "SERVICE PROVIDER/BIDDERS" shall not have any claim over them.

### **ARTICLE 19: COMPLETION OF THE AGREEMENT:**

The present agreement will be considered completed or deemed completed:

- i. After xx months from the date of installation of the equipment by the "SERVICE PROVIDER/BIDDER" and on receipt of the total project value from the Municipality, or
- ii. On the day the "SERVICE PROVIDER/BIDDER" receives complete termination payment in terms of Article-14 of this agreement, or
- iii. On the day the "SERVICE PROVIDER/BIDDER" receives complete termination payment in terms of Articles-15.10 and 15.11 of this agreement.

Immediately on completion of this Agreement the Municipality shall issue an Agreement Completion Certificate to the "SERVICE PROVIDER/BIDDER" discharging them from any liability or obligations in terms of this Agreement.

Upon completion of this agreement either of Party is precluded from invoking the provisions of this agreement and the agreement becomes automatically inoperative and not enforceable any further.

### **ARTICLE 20: MISCELLANEOUS PROVISIONS**

#### **20.1 Governing Law and Jurisdiction**

This Agreement shall be construed and interpreted in accordance with and governed by the laws of India and the Courts of \_\_\_\_\_ (Name of STATE) shall have jurisdiction over all matters arising out of or relating to this Agreement.

#### **20.2 Severability**

If for any reason whatsoever, any provision of this Agreement is or becomes invalid, illegal or unenforceable or is declared by any court of competent jurisdiction or any other legal and valid instrumentality to be invalid, illegal or unenforceable, the validity, legality or enforceability of the remaining provisions shall not be affected in any manner, and the Parties will negotiate in good faith with a view to agreeing upon one or more provisions, which may be substituted for such invalid, unenforceable or illegal provisions, as nearly as is practicable. Provided failure to agree upon any such provisions shall not be a subject matter to dispute resolution under this Agreement or otherwise.

#### **20.3 Entire Agreement**

This Agreement and the Annexures referred therein together constitute a complete and exclusive statement of the terms and conditions of the agreement between the Parties on the subject hereof and no amendment or modification hereto shall be valid and effective unless such modification or amendment is agreed to in writing by the Parties and duly executed by persons especially empowered in this behalf by the respective Parties.

#### **20.4 Compliance with Laws and Directives**

The "SERVICE PROVIDER/BIDDER" shall, in all matters arising in the performance of this Agreement, comply with, give all notices under, and pay all taxes, levies and other similar charges required by the provisions of any Central or State law or directive or any regulation of any legally constituted public

authority having jurisdiction over the Works. The Municipality and the "SERVICE PROVIDER/BIDDER" shall comply with all the laws as applicable.

## 20.5 Notifications

- i. Wherever provision is made for the giving or issuance of any notice, instruction, consent, approval, certificate or determination by any Person, unless otherwise specified, such communication shall be in writing and shall not be unreasonably withheld or delayed. **Wherever provision is made for a communication to be "written" or "in writing," this means any hand-written, typewritten or printed communication, including the agreed systems of electronic transmission.**
- ii. All certificates, notices or written orders between the Parties shall either be delivered by hand against written acknowledgment of receipt, or be sent by registered acknowledgment due pre-paid post or courier or one of the agreed systems of electronic transmission. In the event of any dispute, unless such acknowledgment of receipt is provided, the communication shall be treated as not given.
- iii. **In the case of the "SERVICE PROVIDER/BIDDER," all communication shall be marked for the attention of the person and to the address provided below, or to such other person or address as may be intimated to the Municipality by the "SERVICE PROVIDER/BIDDER" from time to time.**

Name of SERVICE PROVIDER/BIDDER's Representative: \_\_\_\_\_  
Address for communication: \_\_\_\_\_

- iv. In the case of the \_\_\_\_\_ (Name of Municipality) all communication shall be addressed to:

Name of Municipality's Representative: \_\_\_\_\_  
Address for communication: \_\_\_\_\_

## 20.6 Language

The language of this Agreement is the English language. All correspondence, drawings, designs, design data, Tests reports, certificates, specifications and information shall be in the English language. All other written and printed matter required for Implementation, operation and maintenance shall be executed in the English language. Instructions and notices to the public and staff and all other signs **and information's notices shall be in English.**

In witness whereof the Parties have executed this Agreement as of the date first above written.

SIGNED AND DELIVERED BY THE \_\_\_\_\_  
(Name of Municipal  
Corporation), by the hand of  
Mr./Ms. \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_, its \_\_\_\_\_,  
\_\_\_\_\_  
An authorized officer.

SIGNED AND DELIVERED BY the SERVICE PROVIDER/  
BIDDER, pursuant to the Resolution of its Board  
of Directors passed in that behalf on \_\_\_\_\_  
2013, by the hand of  
Mr./Ms. \_\_\_\_\_,  
Its \_\_\_\_\_,

An authorized officer

Annexure 01

## General Specifications

### 1. GENERAL REQUIREMENTS

- a. High Power White LEDs are used in the luminaries and the Wattage of these LEDs would be greater than ONE watt.
- b. LED will be operated at a forward current of less than 90% of the rated current.
- c. Color Rendering Index (CRI) of the LEDs used in the luminaire will be greater than 70.
- d. The illumination of the luminaire will be uniform without dark bands or abrupt variations and soothing to the eye.
- e. Light Uniformity Ratio (E min / E avg.) would be > 0.4
- f. Luminary Body Temperature would be less than 30cC above the ambient, even after continuous burning of Luminary for 24 Hrs
- g. The Luminaire works on single phase three wire system (Phase, Neutral and Earth).

### 2. CONSTRUCTION

- a. a. The luminaire housing is made up of Corrosion free High Pressure Aluminum die cast thus confirming the luminaire to IP-68 protection and safety as per IEC 605981 IS 10312.
- b. b. The Luminaire is equipped with distortion free, clear, Heat Resistant Toughened, UV stabilized Glass cover in the front fixed to the die cast Aluminum frame which would be fixed to the housing by means of stainless steel screws

## Annexure 02

### Specifications of XXW LED Street Light

#### 1. ELECTRICAL PARAMETERS

- a. AC input Operating Voltage range: 90V to 300V AC
- b. AC Input Operating frequency range: 47 ~ 53Hz
- c. Nominal Operating Voltage: 230V AC
- d. Nominal Operating frequency: 50 Hz
- e. Nominal Power Consumption: XXW  $\pm$  5%
- f. Power Factor: > 0.9
- g. Total Harmonic Distortion (THD): < 15%

#### 2. MECHANICAL PARAMETERS

- a. Construction of Casing: High Pressure Die Cast Aluminum
- b. Finish: Powder Coating with Silver color
- c. Luminaire Cover: Toughened Glass
- d. IP Level: IP 68
- e. Mounting bracket diameter (inner): 34.4–42.4mm

- f. Recommended pole height: 6 m
- g. Recommended Tilt: 5 ~ 15°
- h. Recommended Arm Length: 1 m

### 3. OPTICAL PARAMETERS

- a. Correlated Color Temperature (CCT): 5,000K to 7,000K
- b. Luminaire efficacy: >70 lm/W

Month	Repayment
1	
2	
3	
4	
5	
6	
7 etc.	

## **Appendix F: Template for a Tripartite MOU for Deemed Savings Model of Implementation**

### **TRIPARTITE MoU**

**between**

.....**(State Government)**

**And**

.....**(Municipal Corporation)**

**And**

.....**(Service Provider/Bidder)**

.....**(Area-Address)**

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## 1. DEFINITIONS

1.1 In this Memorandum the following expressions shall have the following meanings:

<u>Expression</u>	<u>Meaning</u>
"TPA"	Tripartite Agreement
"State Government"	_____ (Name of State Government)
"MC"	_____ (Name of Municipal Corporation)
"Service Provider/Bidder"	_____ (Name of Service Provider/Bidder)

1.2 References to clauses are to clauses of this Agreement.

## 2. PARTIES TO THE MEMORANDUM

This TPA is between the following three parties:

## 3. BACKGROUND

State Government and the MC invited Service Provider/Bidder to undertake the supply of LED streetlights giving output of lux levels equivalent to the existing lights, which shall include their installation, maintenance and warranty replacement during the project period on the principle of **repayment of the cost of the project by the MC in ..... monthly installments on the basis of** cost reimbursement. In response thereto, Service Provider/Bidder has agreed to install the latest LED street light technology as replacements to the existing lights.

- (i) The Government of \_\_\_\_\_, acting through its Representative \_\_\_\_\_ (hereinafter referred to as the "State Government" which expression shall, unless the context otherwise requires, include its administrators, successors and assigns) of First Part;

And

- (ii) The Municipal Corporation having its office at \_\_\_\_\_, acting through its Representative \_\_\_\_\_ (hereinafter referred to as the "Municipality" which expression shall, unless the context otherwise requires, include its administrators, successors and assigns) of Second Part;

And

- (iii) Service Provider/Bidder is a \_\_\_\_\_ (Service Provider/Bidder description) of Third Part.

## 4. SCOPE

4.1 This Tripartite Agreement provides as a framework for implementation of EE measures in street light, water pumping and sewage pumping in the jurisdiction of MC. The implementation will be undertaken by SERVICE PROVIDER/BIDDER by investing the entire upfront capital cost of EE interventions, including preparation of Detailed Project Report. The investment of SERVICE PROVIDER/BIDDER would be recovered by payment of annual service charge by MC for the duration of the agreement. The actual annual payment of service charges and the duration of the contract will be determined after the completion of the Detailed Project Report by SERVICE PROVIDER/BIDDER.A

separate agreement between STATE GOVERNMENT, MC and SERVICE PROVIDER/BIDDER will be signed consequent upon the finalization of the Detailed Project Report. SERVICE PROVIDER/BIDDER will commence the work of preparation of Detailed Project Report after this TPA is signed.

## 5. Obligations of the Parties

### 5.1 STATE GOVERNMENT

- (i) The STATE GOVERNMENT shall issue all necessary directions/guidance required for implementing the Project.

Grant in timely manner all such approvals, permissions, authorizations which the "SERVICE PROVIDER/BIDDER" may require or is obliged to seek from STATE GOVERNMENT in connection with implementation of the Project and the performance of its obligations under this TPA.

Grant or where appropriate provide necessary assistance to the "SERVICE PROVIDER/BIDDER" in securing applicable permits and exemptions.

STATE GOVERNMENT will, on completion of Detailed Project Report, assist MC and SERVICE PROVIDER/BIDDER in finalizing the annual service charge and project duration after completion of Detailed Project Report by SERVICE PROVIDER/BIDDER.

STATE GOVERNMENT will ensure the signing of the Implementation Agreement between MC and SERVICE PROVIDER/BIDDER.

- (ii) In case of dispute or an ambiguity between the "SERVICE PROVIDER/BIDDER" and MC, the STATE GOVERNMENT shall have the obligation to resolve the dispute/ambiguity.
- (iii) STATE GOVERNMENT will assist MC and SERVICE PROVIDER/BIDDER to finalize payment security mechanism to ensure recovery of investment made by SERVICE PROVIDER/BIDDER.

### 5.2 MC

MC shall assist in getting permissions and exemptions as may be required under laws relating to it and regulating the Project as applicable in the State of \_\_\_\_\_(NAME OF STATE). However the responsibility lies with the SERVICE PROVIDER/BIDDER of getting necessary permissions and exemptions

- (i) MC shall ensure that from the date of this Agreement and till the completion of the project, the "SERVICE PROVIDER/BIDDER" has access to the Project Facilities for the purpose of carrying out the SERVICE PROVIDER/BIDDER'S obligations under this Agreement.
- (ii) MC shall provide all necessary data, access to facilities and other measures that are expedient in preparation of Detailed Project Report by SERVICE PROVIDER/BIDDER.
- (iii) MC will designate an area where SERVICE PROVIDER/BIDDER will demonstrate the energy savings by replacement of existing streetlights/pumps with energy-efficient options. The demonstrated results will be used by SERVICE PROVIDER/BIDDER to work out the annual payment of service charges, project duration and payment security terms in a transparent manner.
- (iv) MC provides an in-principle approval for payment of annual service charges consequent to the preparation of Detailed Project Report and calculation of the annual charges/project duration by SERVICE PROVIDER/BIDDER.

### **5.3 SERVICE PROVIDER/BIDDER**

Carry out the Works strictly in accordance with the provisions of this Agreement.

Undertake to achieve Detailed Project Report completion no later than 3 months from the date of signing this agreement.

SERVICE PROVIDER/BIDDER will furnish to MC and STATE GOVERNMENT the Detailed Project Report, implementation Agreement and payment security terms within 15 days of completion of Detailed Project Report.

SERVICE PROVIDER/BIDDER shall not seek any financial cost/assistance from STATE GOVERNMENT and/or MC for Detailed Project Report preparation.

## **6. TERM**

This Memorandum commences on \_\_\_\_\_ and will remain in force till \_\_\_\_\_ unless rescinded by either party. The Memorandum can be extended further by the mutual consent of both the Parties.

## **7. PROCEDURES FOR AMENDMENT, CANCELLATION, ARBITRATION AND EXCLUSIVITY**

7.1 This Tripartite Agreement may be renegotiated if at any time during its term, the work or environment of the STATE GOVERNMENT, MC and SERVICE PROVIDER/BIDDER, is so altered that the contents of the Memorandum are no longer appropriate.

7.2 Pursuant to this framework agreement, separate implementation agreements will be negotiated between the Parties after completion of the Detailed Project Report.

7.3 This Memorandum embodies the entire understanding of the parties as to its subject matter and shall not be amended except in writing executed by all the Parties to this agreement. Any changes are to be recorded in writing and inserted or attached to this Tripartite Agreement and this will have the effect of updating the Tripartite Agreement.

7.4 In case of any dispute or difference arising between the Parties arising out or in relation to this Tripartite Agreement, the same shall be referred to STATE GOVERNMENT.

## **8. COOPERATION**

8.1 STATE GOVERNMENT, MC and SERVICE PROVIDER/BIDDER will consult with each other, whenever it may be appropriate, on the matters covered by this TPA and will use their best endeavors to ensure that staffs of the organizations cooperate in good faith with one another.

8.2 All Parties should apprise / keep each other informed on project related matters. If any issue or dispute arises between STATE GOVERNMENT, MC and SERVICE PROVIDER/BIDDER, they will use their best endeavors to resolve the dispute promptly.

## **9. SIGNATURES**

IN WITNESS WHEREOF, the Parties have entered into this Tripartite Agreement, the day and year as mentioned under Clause 6, above.,

**Witness**

1.

Name

Designation

Executed for STATE  
GOVERNMENT  
By its duly Authorized  
Representative

2.

Name

Designation

Executed for MC  
By its duly Authorized  
Representative

3.

Name

Designation

Executed for SERVICE  
PROVIDER/BIDDER  
By its duly Authorized  
Representative

## Appendix G: Additional EE Street Lighting Case Studies

COUNTRY	REPLACED EE STREET LIGHTING TECHNOLOGY	SUMMARY
<b>EUROPE</b>		
<b>Belgrade, Serbia</b>	266 luminaires replaced with LED technology	<ul style="list-style-type: none"> <li>• Bulevarkralja Aleksandra, longest street in Belgrade. 2.5km lit with LED</li> <li>• Local installer is the main contractor and it is based on the public procurement model</li> <li>• Hardware from Philips (CitySoulLEDGine BGP430 with 48 LED, 4,000K, 60W)</li> <li>• 266 luminaires installed</li> <li>• 40% annual energy savings from the baseline</li> </ul>
<b>Poznan, Poland</b>	HID is replaced with the LED technology	<ul style="list-style-type: none"> <li>• Uses Philips Iridium, Traffic Vision, Marbella SGS 203, Malaga</li> <li>• Replaces HID</li> <li>• 1,300 luminaires</li> <li>• Streets and stadium</li> <li>• Adds intelligent remote controls</li> <li>• 50% efficiency gains achieved from the baseline</li> </ul>
<b>Skabrnja, Croatia</b>	HID is replaced with the LED technology	<ul style="list-style-type: none"> <li>• Uses Philips MiniIridium LED</li> <li>• Replaces HID</li> <li>• 600 luminaires</li> <li>• CityTouch intelligent controls</li> <li>• 62% efficiency gains achieved from the baseline</li> <li>• Estimated 2.8 years payback period</li> </ul>
<b>Krsko, Slovenia</b>	HID is replaced with the LED technology	<ul style="list-style-type: none"> <li>• Designed by Philips</li> <li>• Uses Philips Iridium 2 LED, Mini Iridium LED and CitySoul LED</li> <li>• Replaces HID</li> <li>• 1,200 luminaires</li> <li>• 43% efficiency gains achieved from the energy consumption baseline</li> </ul>
<b>Vienna, Austria</b>	Estimated 5,000 luminaires replaced with LEDs	<ul style="list-style-type: none"> <li>• 5,000 luminaires total, 1,200k in the first tranche</li> <li>• E77k savings per annum</li> <li>• Service contract, investments are paid from savings</li> <li>• City of Vienna precludes securitization of payments by supplier</li> </ul>

<b>North America</b>		
<b>Iowa, USA</b>	Mostly HID replaced with LED	<ul style="list-style-type: none"> <li>• Fifteen towns in Iowa, USA, have pooled their purchasing of LED lights to arrive at a greater discount</li> <li>• Uses Leotek luminaires</li> <li>• Covers three different types of Cobrahead fixtures</li> <li>• Replaced mostly HID</li> <li>• 1,100 luminaires</li> <li>• Payback varies from 2.4 to 9.5 years over the participating municipalities</li> </ul>
<b>Seattle, Washington, USA</b>	HPS replaced with LED	<ul style="list-style-type: none"> <li>• 41,000 streetlights (HPS) to be replaced with LED, beginning in 2010, ending in 2014</li> <li>• Overall cost: US\$24m</li> <li>• Field evaluation of the final two vendors. One vendor failed in the field because of quality problems (water in housing)</li> <li>• Replacement of 100W HPS cobra head with LED</li> <li>• Economics for 2010 phase 1 (5,000 lights replaced): US\$294,000 annual savings and US\$2.465 initial investment</li> <li>• 40% savings before any smart controls, additional 20% expected from smart controls</li> </ul>
<b>Asheville, North Carolina, USA</b>	HID and HPS replaced with LED technology	<ul style="list-style-type: none"> <li>• 9,000 streetlights replaced with LEDs, conversion over 4 years</li> <li>• Vendor: Cree Ledway</li> <li>• On average 50% operating cost reduction, amounting to US\$638k p.a.</li> <li>• US\$71 is saved per light per year</li> <li>• 5.1 year payback</li> <li>• 13 years financing, resulting in US\$3.3m net savings after financing after 13 years</li> </ul>
<b>Anchorage, Alaska, USA</b>	HPS is being replaced by the LED technology	<ul style="list-style-type: none"> <li>• LEDs are replacing 16,000 150W HPS streetlights, about a quarter of total streetlights</li> <li>• Project started in 2008</li> <li>• Special requirement: Protect Alaska night sky vision with backlight shields</li> <li>• Used LEDway streetlights with 60 LEDs, Type III medium optics, 700mA, color temperature 4,300K</li> <li>• Savings of US\$360k/year</li> </ul>
<b>South East Asia</b>		
<b>Manila, Philippines</b>	Replaced sodium lights with LED	<ul style="list-style-type: none"> <li>• Exploratory pilot</li> <li>• Replaced Sodium lights (250W, US\$50) with LED lights (90W, US\$512)</li> </ul>

		<ul style="list-style-type: none"><li>• Power consumption falls from 1,205kWh/year to 394kWh/year</li><li>• Savings amount to US\$200/year/fixture</li><li>• Payback is 2.5 years period</li></ul>
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Source: IFC 2013b.

Through these case studies, this manual has tried to include major EE street lighting projects that are being undertaken in all the regions. We have collected information about these case studies through secondary research, case studies showcased during the World Bank Street Lighting Conference held in New Delhi in March 2014, and IIEC data from its previous projects. This is a small sample of many potential case studies.

## Appendix H: The IEA's 4E SSL Street Lighting Performance Tiers

Government officials from 13 countries participating in the International Energy Agency's Energy Efficient End-use Equipment (IEA 4E) implementing agreement have identified solid state lighting (SSL) technologies as having the potential to cut global lighting electricity consumption by 30%. While SSL technologies promise high performance, the recent experience with compact fluorescent lamps has demonstrated the need to prevent unwarranted performance claims, which can seriously damage consumer confidence and slow down market acceptance of this emerging energy-saving technology. **Twenty technical experts from the SSL Annex's nine member countries: Australia, Denmark, France, Japan, Korea, The Netherlands, Sweden, United Kingdom, and United States of America and expert member country China** have worked together to develop performance tiers for Light Emitting Diode (LED) based lighting. Several performance tier levels were set to address the various priorities and needs from each country or region. This approach is expected to help participating governments to define globally consistent requirements for programs to promote market adoption of SSL products, as well as being useful for governments planning to adopt national energy policies and regulations covering SSL technologies.

The IEA-4E SSL Annex maintains voluntary performance tiers to address product attributes such as color, lifetime, power, and efficacy for common SSL applications. These product performance tiers comprise a limited number of proposed performance levels, agreed upon by IEA SSL Annex members, that could be utilized by government, non-profit and donor agencies when designing programs and policies. The objective is to provide a limited number of levels that can be utilized by program designers to reduce costs of writing specifications and to facilitate economic advantages for industry/trade. Further, they help minimize compliance costs with SSL programs and policies. Member countries are not obligated to use the tiers, and they are not international standards.

The SSL Annex has published performance tiers associated with the following LED lamps and luminaires:

1. Non-directional Lamps for Indoor Residential Applications
2. Directional Lamps for Indoor Residential Applications
3. Downlight Luminaires
4. Linear Fluorescent LED Lamps
- 5. Linear Fluorescent LED "Retrofit" Lamps**
6. Outdoor Lighting (Street Lighting)

To view these performance tiers, visit our website: <http://ssl.iea-4e.org/task-1---quality-assurance>

## Appendix I: List of Financing Mechanisms and Schemes for Energy Efficiency Implementation in India

Table 0.1: List of Financing Mechanisms/Schemes for Energy Efficiency Implementation in India\*

	Title of the Financing Mechanism/Scheme	Sponsor/	Objectives	Targeted Sectors	Financing Instrument	Status
DEBT	JICA-SIDBI Financing Scheme for Energy Savings Projects in MSME Sector	JICA	To support energy saving investments in plants and machinery in the MSME sector	MSME	Credit Line from JICA to SIDBI	2012-on-going
	IREDA EE Financing Scheme	World Bank	To provide equipment financing, project financing and loans for RE and EE manufacturing.	Industrial, commercial and municipal	Credit line from World Bank to IREDA	2004, concluded in 2006
	ADB-Industrial EE Project	ADB	To support investments in EE and related environmental improvement measures by energy-intensive industries in India	Industrial	Loan from ADB to IDBI for onward lending	1994, concluded in 2000
	USAID- Energy Conservation Commercialization (ECO-I) Program	USAID	To demonstrate different approaches and financial mechanisms for increasing access to commercial financing for EE projects	Industrial, commercial and municipal	Loan from USAID to ICICI bank for onward lending	2002, concluded in 2004
	ICICI Bank lending for EE	World Bank	To finance projects on EE in the sectors of interest	Industrial, commercial, SME and public	Credit line from World Bank	
	KfW Credit Line for EE	KfW	To finance EE improvements in the MSME sector, to overcome the internal barrier of lack of capital in SMEs	MSME	Credit line from KfW to SIDBI	2011, concluded in 2013
	Technology Innovation Fund	TIFAC-GOI	Provide financial assistance for development, up-scaling, demonstration and commercialization of innovative technology-based projects including EE	MSMEs	Revolving fund to provide soft loans	2011-on-going
	SBI EE Loan scheme for MSMEs	SBI	Provide technology upgrades and equipment financing for energy-efficient equipment to existing bank customers	Mostly SMEs	EE focused commercial bank loan	Not Available (NA)
	SBI Green Home Loans	SBI	Encourage investments in green homes by providing easier loan terms	Residential	Home loan to home buyers	NA
	Canara Bank-Energy Savings Loan Scheme for SMEs	Canara Bank	Concessional loan financing of SME EE projects by providing partial grant for energy audits.	SMEs	Concessional Loan	NA
	Union Bank of India EE Loan Scheme for SMEs	Union Bank of India	Provide technology upgrades and equipment financing for energy-efficient equipment to bank customers	SMEs	Concessional Loan	NA

	Yes Bank Initiative for EE lending	Yes Bank	Provide technology upgrades and equipment financing for energy-efficient equipment to bank customers	SMEs, industrial, commercial and agriculture	Loan focused on EE	NA
FISCAL	Accelerated Depreciation	GOI	To improve economic attractiveness of investment in EE	Industrial	Depreciation benefits for a range of EE equipment and devices	On-going *DOES ON-(it is active and can be availed)
	Greater Noida Development Authority incentive for Green Buildings	GOI	Incentivize construction of Green Buildings in the Region	Residential and Commercial Real Estate	Additional Floor Area Ratio (FAR) of 5% for IGBC rated green buildings	On-going
	Municipal Corporation of Greater Mumbai and Pune Municipal Corporation Rebate for Eco-Housing	GOI	Incentivize construction of Green Homes	Residential	Rebates for certified Eco-Housing projects on development fees paid by developers and property taxes by residents	Planned
EQUITY	Green India Venture Fund	IFCI Venture, other FIs/Banks/companies/Multi laterals	To invest in projects which reduce or eliminate negative ecological impact, productive use of natural resources and promote use of RE resources	Varied	Equity investments	On-going
	Global Environment Fund	ADB, OPIC, IFC, Wells Fargo and JBIC	To invest in businesses providing cost effective solutions to environmental and energy challenges	Industrial and companies -wind, solar and off grid solar	Equity investments	On-going
	BEE Venture Capital Fund for Energy Efficiency	GOI	To ensure adequate risk capital is made available for EE projects in India	Industrial, commercial and municipal	Equity investments	To be launched
GRANT	Technology Up gradation Fund Scheme for Textile Industry	GOI	To facilitate modernization and technology upgrades (including EE) in the textile sector	Textile	Interest reimbursements or capital/margin money subsidies	1999-2012
	Credit Linked Capital Subsidy Scheme	GOI	To facilitate technology upgrades (including EE) in the specified products/subsectors in the SSI sector	MSME	Upfront capital subsidy	NA
	Scheme for Technology and Quality Up gradation Support to MSMEs	GOI	To enhance the competitiveness of the MSME sector through EE and product quality certification	MSME	Grants for capacity building of MSME and proportion of project cost for implementation of EE technologies	2010-ongoing
GOI Funds and Schemes	Perform, Achieve and Trade (PAT) Scheme	GOI	To facilitate EE improvements in energy intensive large industries	Industrial	Trading of energy savings certificates	On-going
	BEE Partial Risk Guarantee Fund for EE	GOI	To leverage commercial financing for EE	Government buildings and municipalities	Provides partial risk guarantees to financial institution funding EE projects	To be launched
	World Bank- Partial Risk Sharing Facility (PRSF)	World Bank/SIDBI	To achieve energy savings by catalyzing the EE projects intended to be implemented through energy service companies (ESCOs) in India	Large-scale industries including PAT sectors;	The PRSF comprises of a risk-sharing fund corpus of US\$35 million implemented by	To be launched

			Micro, Small and Medium Enterprises (MSMEs); Commercial Building; Municipal Energy Efficiency Projects including street lighting	SIDBI, the Project Execution Agency (PEA) and funded from the CTF contribution of US\$25 million and a GEF contribution of US\$10 million (Component 1) and a TA and capacity building component from a GEF component of US\$8 million, with US\$6million implemented by SIDBI and US\$2 million implemented by EESL.	
<b>Credit Guarantee Trust Fund or Micro and Small Enterprises (CGTMSE)</b>	GOI	To encourage banks to lend to small scale industries. Also includes EE intervention projects of SSIs	SSIs	Provides credit guarantees to member lending institutions	On-going
<b>National Clean Energy Fund</b>	GOI	Funding research and innovative projects in clean energy technologies	Varied	Viability gap funding or loans	On-going
<b>Kerala State Energy Conservation Fund</b>	GOI	To promote implementation of EE projects in Kerala	Industrial, Commercial, municipal, public buildings and residential	Loans, guarantees and grants	On-going

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