



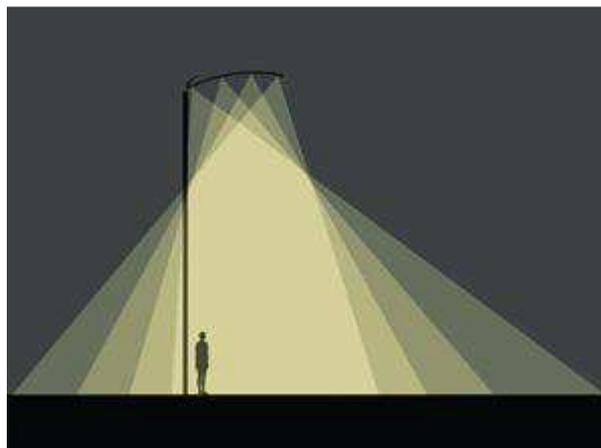
## **Step-by-step Guidance Document to Streetlight refurbishment**

Street lighting can account for up to 30-50% of the total electricity consumption of local authorities. The recent market introduction of LED technology for street lighting offers high savings with comparatively short pay-back times.

There is an urgent need to act for local authorities, nearly 80% of all currently used street lighting lamps will be "phased out" by 2017, which means they will not be available for purchase. Whereas refurbishment can significantly increase energy efficiency and reduce electricity and maintenance costs, it requires substantial upfront investments. This is a major problem for many local authorities.

Here energy performance contracting (EPC) can be a solution, energy efficiency investments are pre-financed and implemented by an energy service company (ESCO). The annual energy and maintenance cost savings then cover the investment and capital costs.

This document provides a practical step-by-step guidance to local authorities and ESCOs on implementing streetlight (EPC) projects.



## Refurbishment of Street lighting with LED and EPC

### Why refurbishment?

Street lighting is an important contributor to traffic and public safety. Assuring good visibility during hours of darkness also requires a substantial amount of electricity and money. For local authorities with older, inefficient systems, street lighting can account for 30-50% of their total electricity consumption. However, the savings potential in this field is enormous, in many local authorities 30-70% is achievable with current technologies.

### Why LED?

The recent market introduction of LED technology for street lighting offers high savings with comparatively short pay-back times (typically around 5-7 years without civils). LED technology has been developing very rapidly over the past years. With cost reduction potentials of over 50%, in many cases it is now a very interesting option for street lighting refurbishment.

Some advantages of LED:

- high energy efficiency
- low maintenance requirements
- no UV and IR radiation
- exact light direction possible (good for animal night life)
- high flexibility, dynamic light control systems
- long lifetime (about 50-70,000 hours)

### Why Energy Performance Contracting (EPC)?

Streetlight refurbishment to LEDs requires significant investments which is a major barrier for most local authorities. Energy Performance Contracting (EPC) can offer a solution in many cases to overcome this barrier.

Energy Performance Contracting is a contractual arrangement between a beneficiary (e.g. a local authorities) and a provider of an energy efficiency improvement measure, a so-called "Energy Service Company" (ESCO). The ESCO finances and implements energy efficiency investments - for example the refurbishment of a street lighting to LED technologies for the whole county or a number of pre-identified similar projects. The annual energy savings are used to cover the investment and capital costs. After the end of the contract, the client benefits from the energy and cost savings.

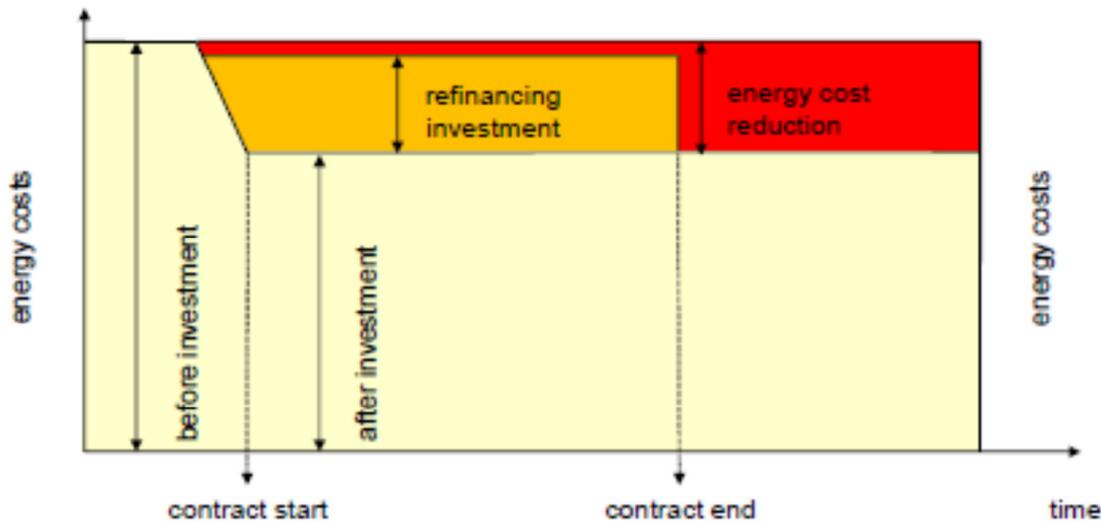


Figure 1: Typical Example of EPC Project

Energy efficiency investments are pre-financed and implemented by an energy service company (ESCO), the annual energy savings then cover the investment and capital costs.

## The basics of EPC explained

### "Basics"

Definitions in Figure 1 explained;

- **Energy Costs:** (Figure 1)  
Energy cost relating to the lighting project before retrofit.
- **Before Investment; Baseline:** (Figure 1)  
Reference value that is calculated based on the energy costs and energy consumption which were incurred within a reference period (e.g. the last 3 years).
- **Refinancing of the investment:** (Figure 1)  
Refinancing of the investment is done with the achieved energy savings.
- **Energy Cost Reduction:** (Figure 1)  
A small energy saving over the contract duration, full energy savings realised after the contract ends.

Definitions of the following terminology;

- **ESCO Client:**  
Local authorities/public body (or company) in whose installations an ESCO project is carried out.
- **ESCO Contract:**  
The basis for the cooperation between ESCO and client, regulates rights and obligations for both parties, mostly important the achieved savings, the contract duration and warranty issues.
- **ESCO:**  
Specialised company that offers EPC services
- **Quality assurance:**  
Guarantees assuring the agreed quality level of the ESCO's work (e.g. minimum savings, functionality of the system)

## Frequently Asked Questions

- **What measures are typically implemented in a street lighting EPC project?**

Replacement of lamps, retrofitting of existing installations, new control systems, system optimisation, retrofitting of poles, complete replacement of luminaires. Extending the street lighting system can be incorporated into the project, but cannot be financed by savings.

- **What size of investment is typical?**

This really depends on the project and its size. However, in many cases, a minimum investment of circa €50,000 is the minimum, otherwise the cost of preparing the project (including setting up the contract) represent too large of a proportion of the savings.

- **What impact does the EPC project have on the local authority staff in respect to the existing service provider?**

The EPC may result in new tasks for the staff previously in charge of some aspect of the street lighting system, such as data collection, quality control, the implementation of the measures and the revision of annual accounts.

- **How time consuming is an EPC project for the local authorities?**

Careful preparation and development are crucial for the successful implementation of an EPC project. At the beginning of the project, all concerned staff should be involved in order to ensure transparency and acceptance by all parties. Good planning of the project and clear requirements for the ESCO in terms of quality criteria are required.

- **How are the reference costs (baseline) determined?**

The "baseline" is the basis for calculating the ESCO's fee. To prevent the factors which are out of the ESCO's control (e.g. energy prices, change of operation times) act to its advantage or disadvantage, energy costs and energy consumption levels are compared to those of the reference year.

- **Is an EPC project possible for every street lighting system?**

In principle, it is possible to find technical and economically feasible energy savings for almost every street lighting system that is more than 10 years old. However, in order to be economically feasible, an EPC project must have a certain minimum size (e.g. investment costs in order of several 10,000 Euro).

- **When does an EPC project make less sense?**

Whether implementing energy efficiency investments with or without EPC is more advantageous depends, among other, on the following factors:

- the size of the project
- the availability of investment funds and personnel capacity
- the purchasing conditions for the lamps and luminaires

- **Who bears which risk?**

The ESCO bears the technical and financial risk for the successful implementation of the project, especially in relation to the guaranteed savings. In order to protect the local authorities from damages resulting from the ESCO's eventual economic difficulties, it is advisable to take precautions in this respect in the EPC contract.

- **As of when does the client benefit from the energy savings?**

Depending on the EPC contract, the local authorities may either benefit from lower energy costs at the beginning of the project (this will most probably entail a longer contract duration) or only after the contract ends.

- **How long is the local authorities contractually bound to the ESCO?**

Typical durations of EPC contracts vary between 7 and 12 years, but depending on the conditions they can also be shorter or longer.

- **Can other measures such as the extension of the existing installation or the lighting of a new road be included in the EPC project?**

Yes. This has the advantage that the local authority can benefit from the ESCO's know how in this field. However, in these cases, a down payment is usually required because extensions cannot be financed by savings.

- **Who owns the street lighting installation when an EPC project is implemented?**

The local authorities remains the owner of the retrofitted facilities. (The NRA in marked networks and motorway sites)

- **What happens at the end of the EPC contract period?**

At the end of the contract period, the local authority can take over the ESCO's tasks again and benefit solely from the lower energy costs. Of course, the agreement may also be extended or amended.

- **How does a local authorities find a suitable ESCO?**

The CKEA "EPC Facilitation Service" will help you to identify potential ESCOs.

## Questions from the Streetlight EPC Q&A session

- **How long does setting up a project typically take?**  
From start until finish, the entire project usually takes from 2-3 years.
- **What are the key criteria (financial and nonfinancial) in tender procedures for selection of ESCOs?**  
In addition to economic criteria, quality criteria for the lamps are important and the quality of the guaranteed savings.
- **Is maintenance of public lighting a part of the same tendering procedure for EPC services?**  
In any case maintenance should be included in the contract as it is a very important part for total savings, however, there are a number of options on how to include maintenance.
- **Should supply of electricity be including in tender process?**  
If it is included in the contract, the local authority would not be allowed to change electricity suppliers for the whole duration of the contract (no possibility to change to a cheaper supplier). Current Office of Government Procurement framework will dictate this.
- **How is the level of savings set?**  
The savings level is determined by the initial analysis and is measured before and after refurbishment.
- **What happens if the savings are not achieved/delivered?**  
The ESCO needs to pay compensation to the local authority.
- **What happens if the savings are higher than estimated in EPC contract?**  
This needs to be defined in the contract. In Upper Austria, the revenue from extra savings most often goes to the local authorities. In any case, the local authorities ends up winning from any extra savings that are achieved, since they will end up with a more efficient lighting system at the end of the contract.
- **Will the project cost more (because of the cost of the ESCO)?**  
The added costs will probably be similar to those of hiring the services of a good expert/consultant. However, in most cases in the long run, the EPC project will help you save money (the ESCO in general has stronger buying power when it comes to purchasing lamps/luminaires).
- **How does a city/local authority guarantee for payments (based on energy/costs savings) to ESCO?**  
Where a local authorities' credit rating is low, this can be done with bank guarantees. If a bank guarantee cannot be obtained, in some counties, the department (national) level might guarantee, otherwise the local authority is not a good candidate for EPC (Knock Out criteria, Step 1 of EPC Quick Checks).

- **Does an ESCO guarantee for whole public lighting systems or just luminaires if only luminaires where a part of reconstruction?**

The ESCO only guarantees for their own installations (those parts that they have installed). The rest is the responsibility of the local authority.

- **What if the cost of electricity goes way up?**

The contract guarantees energy savings. Therefore, any increase in electricity cost is the responsibility of the local authority and is paid to the utility through the electricity bills.

- **How is the cost of the infrastructure (poles, cabling, ducting) taken into account in an EPC finance model? Who pays for the new infrastructure?**

When the ESCO calculates the total investment cost, it usually includes all costs that it has for the implementation of the project: material, installation, staff costs, etc. When a local authority wants to change other installations other than the luminaires (switch boards, cabling, pillars, etc.), these costs can be considered in the project costs, but can most often not be financed through the energy savings. In these cases, the local authority has the extra cost of financing these parts of the installations. Most likely under health and safety grounds or even in the case of moving away from traditional ESB Network pole configuration.

- **What happens if technology changes?**

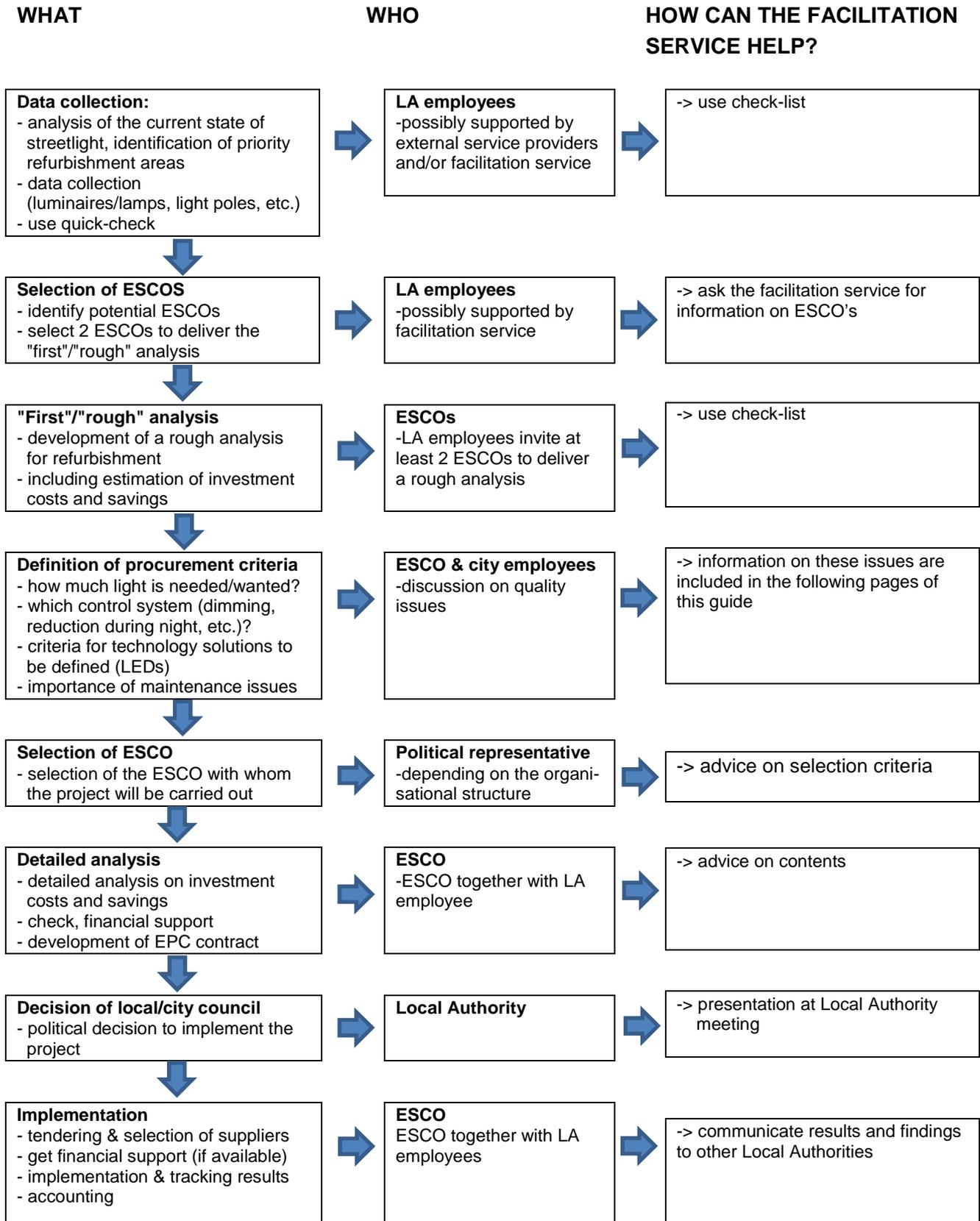
Nothing, because you have a contract guaranteeing the lighting level and savings (which will still be achieved, regardless of the development of technology).

- **What happens if the ESCO goes bankrupt?**

There is the possibility that ESCOs guarantee each other's EPC contracts. In case an ESCO goes bankrupt, the contract is taken over, under the exact same conditions, by another ESCO. Respective provisions could be foreseen in the EPC contract.

## Steps in implementing a Streetlight-EPC project

This is a proposal for a process to implement a streetlight-EPC project.



## Examples of Streetlight-EPC Projects

### Kilkenny County Council – Kilkenny City

#### Potential EPC Example for Ireland

- Population: 24,423
  - Pilot LED Project: LED lighting introduced in Kilkenny City in 2014
  - As first project step, a number of locations were used as a testing ground for LED in Kilkenny City (main street, housing estate and pedestrian street)
  - A mixture of 55W, 85W, 150W and 250W SOX and SON lighting were replaced with 34W, 38W, 43W, 50W, 137W LED
  - 61 lighting units were replaced with LED using LED street lighting, LED heritage style lanterns and LED decorative lighting.
  - The lighting incorporates DALI dimmable lighting to introduce dimming at hours of reduced traffic flow leading to higher energy savings, this will increase the life span of the installation and reduces light pollution at a future date.
  - Various models of LED were used to answer the specific needs of each section of the streetlight system.
  - Investment by Local Authority: €50,000
  - Contract duration: Potential EPC contract duration of 7 or 10 years.
  - Potential annual savings: 54.54%
- Electricity consumption reduced by approx. 15,132kWh/year  
Savings: €2,118.48/year electricity and €1,537/year maintenance costs



## LED technology for street lighting

### Quality criteria for LED street lighting

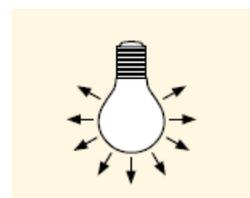
When preparing LED street lighting projects, it is very important to set quality criteria. These can be used for making tenders and to compare different offers.

Key quality criteria (technical specifications) for a street lighting refurbishment project include:

- electrical power (wattage)
- luminous efficacy (light output)
- light colour
- expected service life
- the ability to switch-on/switch-off and control the system (incl. dimming)
- test certificates

- **Luminous flux [lumen]:**

Indicates the light output - how bright a lamp shines. Attention should be paid to whether the lumen specification refers to the LED chip or the entire luminaire.



- **Luminous efficacy [lm/W]:**

Luminous flux (how bright the light shines) in relation to the electricity consumption. This permits to determine how efficient a light is and to compare different products.



- **Lifetime of LED and lights [hours]:**

Manufacturers promise a service life of up to 100,000 hours, although only for individual components rather than for the entire system. Close attention should be paid to the details and guarantees should be requested. This is also crucial for maintenance costs.



- **Rate of decline of the luminous flux:**

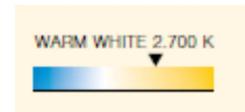
When used correctly, LEDs have an extremely low failure rate. However, as with all lights, the luminous flux will decline over the product's life (reduction of up to 70% after 50,000 hours of operation). This means that - in order for a lighting system to fulfil standards - it either needs to be significant over-dimensioned at the time of installation (not recommended) or an electronically controlled luminous flux compensation system needs to be used. This keeps the luminous flux approximately constant over the installation's operation life.

To evaluate the lifetime of LEDs, the specifications of failure rate and the luminous flux decline rate should be taken into account separately.

Example "L70/B50": "L70" means that the light will still emit at least 70% light at the end of the indicated life span. The "B value" indicates how many lights will fail according to statistics: B50 = 50%.

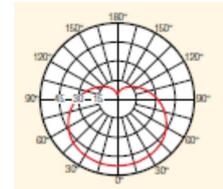
- **Light colours [Kelvin]:**

"Warm" (less than 3,300 Kelvin) or "cold" (neutral white or cold white 3,300-5,300 Kelvin) light. The higher the colour temperature, the more energy efficient LED light is. Daylight-white LEDs (about 5,300 Kelvin) have a 15% higher light output (luminous efficacy) than warm white LEDs.



- **Beam angle:**

LEDs often have a smaller beam angle than conventional lights; therefore, more lamps lights may be required.



- **Effective "thermal management" (heat dissipation):**

About 65%-80% of the electricity consumed by an LED is converted to heat. Good heat dissipation has a significant impact on the life of the LED and is thus an important quality characteristic. Therefore, high-power LEDs are equipped with appropriate cooling fins or other heat dissipation components.



- **Light management and controls:**

Light controllers allow for a more specific switch-on, switch-off times and dimming of the lighting system - an important requirement for demand-driven lighting. Not all LEDs are dimmable.



## More tips for the conversion to LED technology

- **Prefer modular construction:**  
Some LED and electronic modules cannot be separated from the light fixture, therefore in the case of failure, the entire luminaire must be replaced.
- **Minimise glare:**  
Due to LEDs' small light emitting surface an extremely high luminance (up to about 10,000,000 cd/m<sup>2</sup>) arises and can lead to glaring. Precautions should be taken to minimise glare.
- **Availability of spare parts:**  
Different to conventional discharge lights, there is not yet a standardisation for LED lamps (size, plug, mounting, ballasts, etc.). It is therefore important to ensure the availability of spare parts for the lamp's planned service life.
- **Warranty:**  
Length and conditions of the warranty should be precisely defined.
- **Complete technical specifications:**  
In addition to a lighting calculation, a data sheet with the following points should be requested from the ESCO: electrical power (wattage), luminous efficacy (light output), light colour, expected service life, the ability to switch-on/switch-off and control the system (incl. dimming), assembly instructions, test certificates.
- **Retrofit solutions:**  
Replacing conventional lights in conventional luminaires with LEDs is usually problematic in terms of light direction and heat dissipation and may result in loss of system warranty. Also, the advantages of LED (such as targeted light directing, high efficiency, etc.) are usually not exploited in such solutions.

## Support for local authorities on street lighting refurbishment

As an important activity of the "Streetlight-EPC service", the Carlow Kilkenny Energy Agency will support local authorities and ESCO's in implementing street lighting refurbishment and EPC projects. The information and advisory service includes the following activities:

- a dedicated website on EPC and on street lighting at <http://www.streetlight-epc.eu/> with an overview of existing ESCOs, project examples, FAQs, funding and contractual information
- publications and events
- advice on specific projects, pre-check of projects/contracts

The support for local authorities will also include information on financial support available from regional, national and European programmes.

The financial supports available for energy efficiency projects are continually changing and evolving. It is worth investigating alternative sources of funding such as;

- Energy Efficiency Grant Programmes
- Energy Credit Sales
- Innovative Energy Project Development Supports

Please contact the Carlow Kilkenny Energy Agency for the latest financial supports available for streetlighting.

## The Streetlight-EPC Project

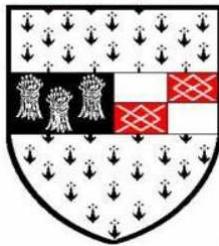
*Triggering the market uptake of energy performance contracting through street lighting refurbishment projects.*

The EU-Project Streetlight-EPC is funded by the Intelligent Energy Europe Programme and was launched in April 2014 with the objective of triggering the market uptake of EPC through street lighting refurbishment projects. The project "Streetlight-EPC" will create demand and supply for EPC projects in 9 regions by setting up regional EPC facilitation services. These services will provide comprehensive support to both local authorities and SMEs as potential ESCOs. The project team includes 9 regional agencies/organisations, which will provide the EPC facilitation services, 9 local authorities and a European network.

### Logos of Project Partners:



Carlow Kilkenny Energy Agency



Kilkenny County Council  
County Hall,  
John St,  
Kilkenny

Pilot Demonstration Partner Website: [www.kilkennycoco.ie](http://www.kilkennycoco.ie)

## Implementing Streetlight Refurbishment Projects

Street lighting is an important contributor to traffic and public safety that requires a substantial amount of electricity and money. For local authorities with older, inefficient systems, street lighting can account for 30-50% of their total electricity consumption. However, the savings potential in this field is enormous – in many local authorities 30-70% with current technologies.

This high efficiency potential was recognised by European policies, which has led to phasing out requirements (between 2010 and 2017) for many lamp types. As a result, they will no longer be purchasable. Nearly 80 % of all streetlamps currently in operation will be affected by this. Local authorities are under strong pressure to act.

The recent market introduction of LED technology for street lighting offers high savings with comparatively short pay-back times. LED technology has been developing very rapidly over the past years. With cost reduction potentials of over 50%, economically it is already a very interesting option for street lighting refurbishment.

Reaping the benefits of efficient street lighting technologies requires substantial upfront investments. That is the major market barrier for operators of street lighting. A functioning and trust-worthy financing model is needed to help local authorities overcome these barriers and succeed in carrying out refurbishment projects.

Energy Performance Contracting (EPC) is potentially a key instrument for financing and implementing economic energy efficiency investments. In the context of EPC, energy efficiency investments are pre-financed and carried out by an energy service company (ESCO). The annual energy and maintenance cost savings then cover the investment and capital costs. Guaranteed energy services in the form of EPC work best in cases of high energy and cost saving potentials.

This folder provides a practical step-by-step guidance to local authorities and ESCOs on implementing a streetlight-EPC project.

For more information, please contact:

*Paddy Phelan BE MIEI CPM*

*Expert in Energy Performance Contracting*

*The Carlow Kilkenny Energy Agency*

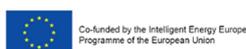
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