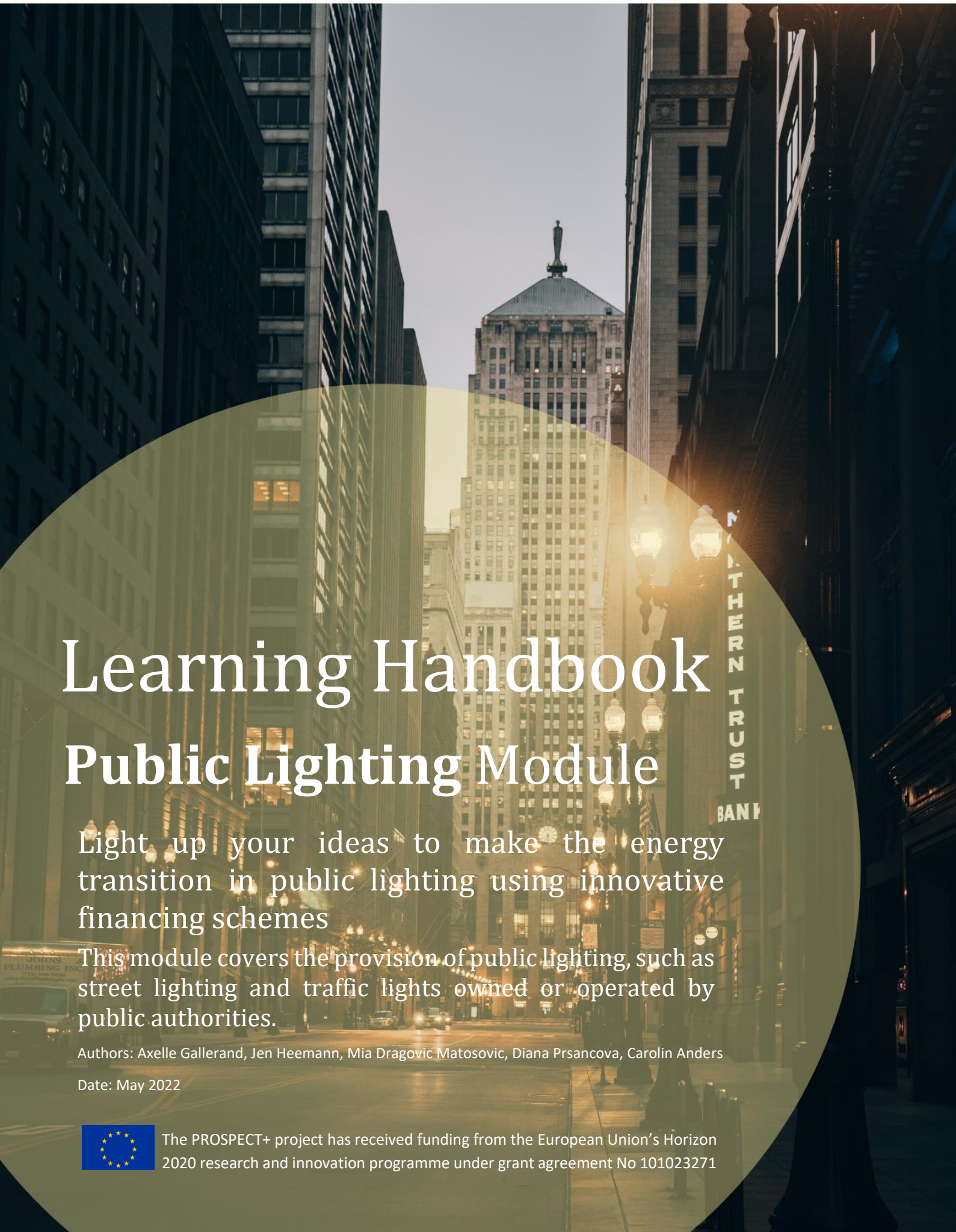
PROSPECT+



Learning Handbook

Public Lighting Module

Light up your ideas to make the energy transition in public lighting using innovative financing schemes

This module covers the provision of public lighting, such as street lighting and traffic lights owned or operated by public authorities.

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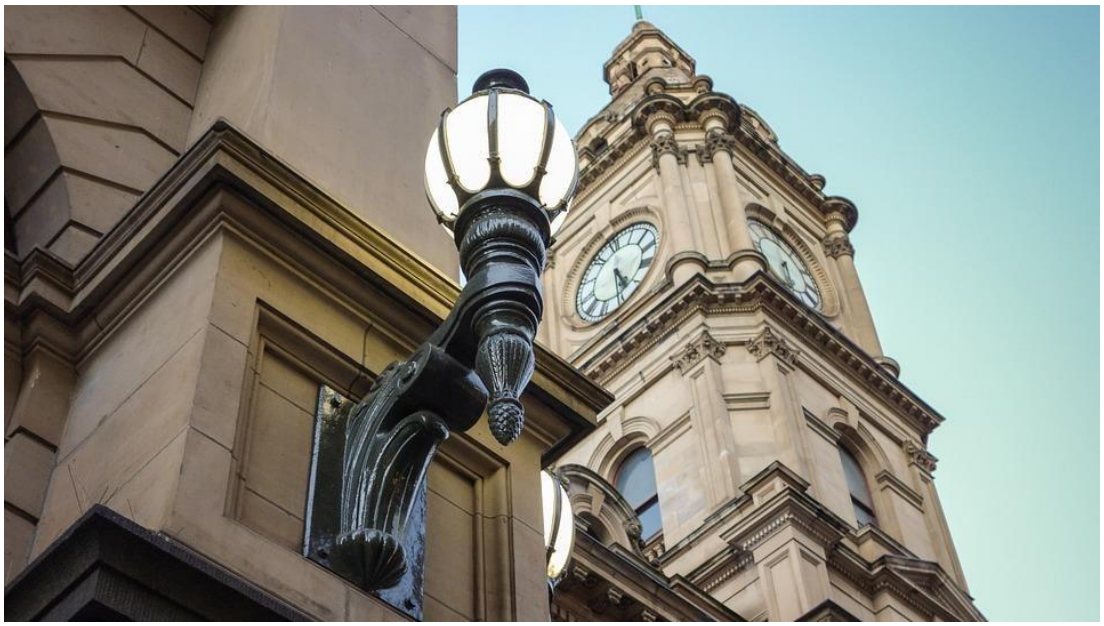
List of abbreviations

EPC	Energy Performance Contracting
EESI	EU Energy Service Initiative
ESCO	Energy Service Company
GPP	Green Public Procurement Criteria for Road Lighting and Traffic Signals

2 Module Description and Objectives

The module on public lighting covers the provision of public lighting owned or operated by public authorities. Examples of public lighting include LED street lighting and integrated renewable power e.g. solar photovoltaic.



Mentee

At the end of this module, mentees can achieve the following learning objectives:

- Understand the innovative financing schemes relevant to public lighting
- Recognise the barriers, incentives, advantages, and disadvantages of the innovative financing schemes
- Understand which steps need to be taken to develop a project proposal with an innovative financing scheme
- Examine which sustainable energy and climate action projects can be financed by innovative schemes
- Analyse the success factors and lessons learnt from successful projects financed by innovative schemes

Mentor

At the end of this module, mentors can achieve the following learning objectives:

- Share content knowledge on the topic of innovative financing schemes that are relevant under the public lighting module
- Share practical experience in implementing sustainable energy and climate action projects and support others in overcoming different barriers
- Showcase sustainable energy and climate action projects in public lighting financed by innovative financing schemes

- Learn from other cities and regions about what projects they want to implement and which innovative financing schemes they want to apply.

3 Public lighting sector

3.1 Sectoral Challenges

Public lighting for roads and public spaces enables road traffic safety and improves the sense of security on the streets. However, public lighting consumes high amounts of electricity. With 636 million street lights, the public lighting sector, in particular, is responsible for about 19% of global electricity consumption and 30-50% of the energy bill of a typical city (Pardo-Bosch et al., 2022). As the installation of efficient public lighting also costs a lot of money, measures for improving lighting infrastructure have not been widely undertaken (OÖ Energiesparverband, 2017).

However, advanced technology nowadays can offer 35-70% of electrical energy savings from the public lighting sector (AIP Conference Proceedings, 2019). Refurbishing the old lighting system with LED technology can save half of the municipal's energy budget. Combining LED lights with networking and intelligent controls can save an additional 30% of the budget (Navigant Consulting, 2017). This is called smart street lighting and has helped Oslo, Norway save 70% of its energy consumption and 1,440 tonnes of CO2 emissions per year (https://www.c40.org/case_studies/10000-intelligent-streetlights-save-1440-tco2-and-reduce-energy-consumption-by-70). Moreover, energy is saved through cheaper and less frequent maintenance, lower lighting replacement cost, and automatization which comes hand in hand with advanced lighting systems.

The EU has acknowledged this energy savings potential and integrated it into the new Ecodesign Working Plan 2016-2019. One of the main targets that are covered in the Ecodesign legislation is street lighting. The Ecodesign Working Plan 2016-2019 ensures that the energy measures must be efficient to be durable and sustainable in the long run1. Further, the EU has revised the EU Green Public Procurement Criteria for Road Lighting and Traffic Signals (GPP) first issued in 2012. The GPP is intended to advise decision-makers on implementation once they decide to install new lighting (IDA, 2019). Consequently, cities and municipalities should be ready to replace the inefficient street lamps, but the amount of investment needed is a big hindrance for many municipalities (OÖ Energiesparverband, 2017). Additionally, the plenty of options when planning to implement smart public lighting can confuse municipalities. The upgrade options can vary from the costs to the networks. Municipalities must assess the various options that can help them achieve their goals and satisfy their needs (Navigant Consulting, 2017).

3.2 Common Barriers

A survey among stakeholders in Central Europe through the DYNAMIC LIGHT project (https://www.interreg-central.eu/Content.Node/Dynamic-Light/Guidelines-financial-models.html) identified the most significant barriers to energy-efficient street lighting investment. The strongest barriers relate to financial and economic obstacles, particularly **insufficient financial resources; shortage of public funding from the national or regional budgets; and high investment costs**.

Further, there is also a **knowledge gap** among stakeholders in terms of existing funding sources – whether public or private – and a need to raise awareness among public authorities. In terms of

[1] Ref. Ares(2018)476175 – 26/01/2018

implementation capacity and procedures, there is also a lack of skills and experience among municipalities, as well as a lack of human resources in the municipality.

Table 1: Summary of barriers to investments in public lighting

Financial and economic	Policies and frameworks	Awareness, access to information and past experience	Implementation capacityand procedures
Insufficient own financialresources	Lack of guidance on the national level	Unfamiliarity and reluctance to introduce new contractual and financing mechanisms	Lack of skills and experience among municipalities
Insufficient national orregional public funding	Poor enforcement of energy efficiency policies	Lack of awareness of potential funding sources	Lack of human resourcesin the municipality
High upfront investmentcost	Energy efficiency is not a priority on the municipal level	Lack of awareness of potential energy savings	Project complexity, including multiple stakeholders

Source: Novikova, et al. (2017)

Learn more about the actors involved in public lighting, the barriers to investment in street lighting upgrades, and the need for awareness and experience on financing by public authorities, by reading the report on the Baseline Inventory of financial models from the Dynamic Light project (https://www.interreg-central.eu/Content.Node/Dynamic-Light/Dynamic-Light-D.T2.3.1-Novikova-et-al.-2017-Financing-Model-.pdf)

3.3 Typical Projects

Typical projects under public lighting can include improvement of public street lighting, energy-saving contracting, integrated renewable energy, and light management systems. Below are the typical projects under public lighting, including a description of their features: from CO2 saving potentials to estimated costs for municipality and target groups and key actors drawn from the SEAP ALPS Project. (https://energiewende-oberland.de/hp1267/Buergerstiftung-waere-naechster-Schritt-zur-Energiewende.htm?ITServ=apsd2o6hctdsjt88imt5nb2270n)

Improvement of public street lighting (LED)

IKK – Energetische Stadtsanierung – Stadtbeleuchtung, known as the Urban Energy Refurbishment – Public lighting) offered attractive financing schemes for German municipalities to improve the energy efficiency of their public street lighting using LED technology. The energy measures that were eligible for the financing schemes included the lighting of pedestrian crossings, parking lot lighting, lighting in public open spaces, traffic lights, etc. The programme supported long-term and low-interest investments. Through this programme, KfW (**German state-owned investment and development bank)** contributes to the implementation of the climate protection goals of the German Federal Government.

Energy-saving contracting

Energy-saving contracting (or Energy performance contracting EPC) helped municipalities in Germany to transform their street lighting into LED using external funding sources. The contractor in this case is an energy service company (ESCO) that designs and conducts the project as well as arranges the project financing. The ESCO guarantees savings on the energy bills which can be used by the municipality to pay

back the ESCO for the project. Once the contract ends, the municipality can benefit from the energy savings.

Integrated renewable energy (photovoltaic)

As part of its commitment to sustainable municipal development, the city of Ascha (Germany) implemented a new solar street lighting system. The existing street lighting was replaced by a PV-powered LED system. This transition to renewable energy sources allows municipalities to save costs in the long term and become independent.

Light management systems

Oftentimes considered smart lighting, light management systems can include light sensors, motion detectors, dimming, etc. Especially dimming of LEDs can be beneficial in street lighting to save energy from midnight until early dawn when public lighting is less needed. Light management systems should be able to reduce light intensity based on time and use.

Table 2: Example of projects under public lighting

Projects	CO2-saving potential	Estimated costs for the municipality	Cost-benefit ratio	Implementation time frame	Target group	Key actors
Improvement of public street lighting (LED)	High	Medium	Medium to high	3 months	Municipality	Municipality, External experts
Energy-saving contracting	High	Very little	High	1 year, the contract will last for 7- 20 years	Municipality	Municipality and ESCO (contractor)
Integrated renewable energy (photovoltaic)	High	Medium	Medium to high	1 month	Municipality	Municipality
Light management systems	Medium	Medium	Medium	3 months	Municipality	Municipality, energy expert

3.4 Good Practices

The table below presents examples of good practices under energy performance contracting, including information on the city or region where the good practice is located, and the source(s) of funds. Most of the projects were implemented in the frame of the project "Streetlight-EPC", funded by the Intelligent Energy Europe Programme (IEE, 2007).

Table 3: Good practices under public lighting

Financing Scheme	City/Region	Good Practice	Source of funds
	Municipality of Gunskirchen, Upper Austria (AT)	Refurbishment of street lighting system to energy-efficient LED technology	ESCO and own Regional budget (subsidies of the regional contracting programme)

EPC	Municipality of Dírná, South Bohemia, Czech Republic (CZ)	Small project: Renovation of public lighting on the main square	Own local budget and local governmentsubsidy
	Municipality of Kostrena, North-West Croatia (HR)	Replacement of street lighting and improvements to parts of the infrastructure (e.g. pole re-placement and repair, relocation of the measuring points, implementation of a street lighting monitoring system).	National Fund and the Environmental Protection and Energy Efficiency Fund
	Kilkenny City, Carlow Kilkenny County (IE)	Improvement of the lighting standard and energy efficiency ofthe street lighting system via EPRP (Energy Performance Related Payment), a type of EPC model	Own regional budget through a grant from the Sustainable Energy Authorityof Ireland (regional contracting programme) + ESCO
	Province of Teramo (IT)	Management of street lighting installations through private companies and ESCOs	Project Development Assistance: IEEand Third-party financing (ESCO)
	Municipality Demir Kapija, Macedonia (MK)	Reconstruction and expansion ofthe existing street lighting system (urban and non-urban)	ESCO (a supplier and equipment provider from the private sector)
	Municipality Gdańsk-Zaspa –Park JP II, Pomerania (PL)	Energy Saving Lighting of Pomerania	Own regional budget and the Voivod Fund for Environmental Protection andWater Management in Gdańsk
	Kalmar, Southeast Sweden (SE)	Lighting renovation of pedestrian and bicycle tunnels with Life Cycle Costs (LCC) calculation	Own Local Budget and ESCOs

3.5 Funding Sources

How can public authorities finance public lighting projects? There are different options for financing public lighting projects. These can range from the city or municipality's own resources to grants from sub-national or European funds. European banks can be one of the financing sources as well as the private sector via ESCOs for EPC and citizens through crowdfunding.

Table 4: Source of funds for public lighting

No.	Source of Funds	Description
1	**Own Local (City or Municipal)or Regional Budget**	Funds are drawn from the budget of local or regional public authorities
2	**National Funds**	Subsidies provided by national governmental bodies or funding through grants from national programmes
3	**European Funds**	Grants and contracts from the European Commission from the Funding and Tenders portal.

	Managed at the EU level	Funds that provide technical assistance and project development, usually for demonstration/pilot projects (e.g. European Innovation Partnership on Smart Cities and Communities, INTERREG Programmes, such as the North-West Europe Programme)
	Managed at the national, regional, or local levels	Funding resources and technical assistance, such as the European Structural and Investment Funds, which are managed by national, regional, or local public authorities in partnership with the European Commission through operational programmes based on strategic goals or investment priorities
4	**European Banks**	These include European Investment Bank, European Fund for Strategic Investments, Private Finance for Energy Efficiency, European Energy Efficiency Fund, and European Bank for Reconstruction and Development
5	**Private funds**	Financing is provided by private contractors, utilities, institutional investors, crowdfunding, and through energy cooperatives

For more information on how to find a suitable financing model for public lighting investment please refer to this guideline. (https://www.interreg-central.eu/Content.Node/Dynamic-Light/Dynamic-Light-D.T2.3.2-Novikova-et-al.-2017-Financing-Model-.pdf)

3.6 Decision Tree

The decision tree represents a flow chart of the most appropriate financing mechanisms to address specific situations faced by municipalities in financing energy efficiency (EE) projects. The scheme is not binding as, in many cases, multiple mechanisms may be combined.

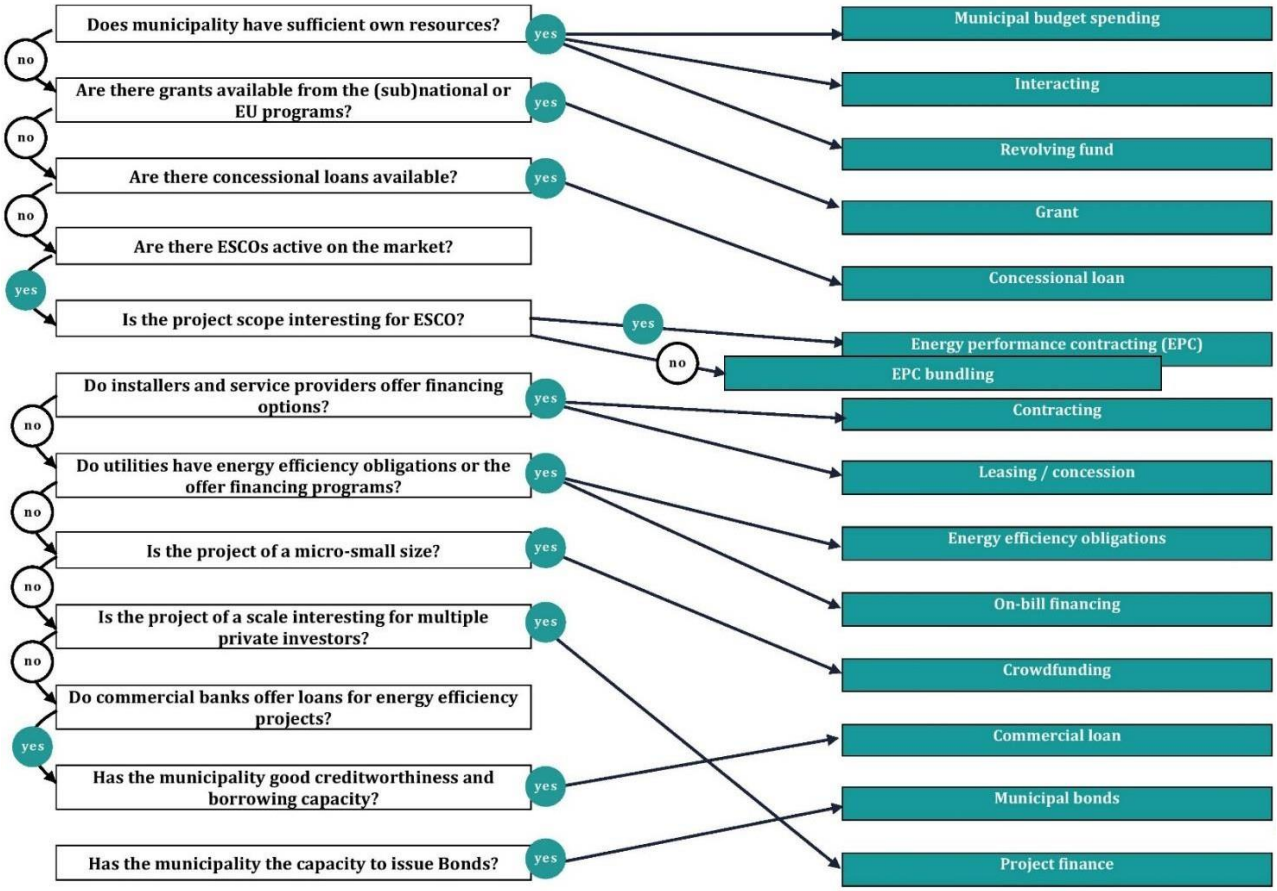
The first thing to address is whether the municipality has sufficient resources to fund the project(s) or not. If the municipality has sufficient financing for the project(s), it can allocate part of its budget for the project(s); by establishing a budget line item for a project and carrying out the mechanism of general budget financing. If the municipality does not have enough funds, it should seek grants available from donors. If there are available grants, the municipality should apply for them. Often these grants do not cover the entire project cost as they represent a mechanism of partial budget financing. It is often possible that funds may also come from the national government; in this case, the municipality will capture a new budget for financing part of the project(s). If the fund does not come from the national government, it is possible to look for energy efficiency funds; this financing scheme is subject to EE fund eligibility criteria.

Besides these funds, commercial banks can also offer dedicated credit lines and/or risk-sharing programmes. To take an advantage of these opportunities, the municipality must respond for its creditworthiness as well as its collateral and borrowing capacity.

Other financing systems can be found in commercial or financial ESCOs; if there are ESCOs in the market the municipality should develop favourable EPCs by negotiating them with ESCOs. If the ESCO is not an option, leasing or vendor financing programmes can be considered. In such a case, when the eligibility criteria are met, similarly to the commercial financing scheme, the municipality should negotiate the leasing or the vendor financing agreement. Finally, if the municipality has the capacity to issue municipal bonds it should create a municipal bond programme by taking into account the transaction costs and market situations.

Select the relevant financing model using a simple decision tree below from the DYNAMIC Light Project:

Figure 1: Decision tree



(https://www.interreg-central.eu/Content.Node/Dynamic-Light/CE452Dynamic-Light-D-T2.3.4-Guidelines-on-finding-a-suitable.pdf)

Source (Novikova, et al., 2017)

4 Innovative Financing Schemes

Innovative financing schemes are non-traditional ways of raising funds and facilitating sustainable energy and climate investments for cities and regions by mixing different sources (own fund, public and private funds) or engaging different partners (e.g. citizens, private sector) aside from established financial institutions (e.g. banks). Below are the innovative financing schemes relevant to this module. Considering the frequency of good practices assessed by PROSPECT and PROSPECT+, this module will only focus on energy performance contracting.

Table 5: Innovative financing schemes under public lighting

Financial Schemes	
Energy Performance Contracting (EPC)	Energy Performance Contracting (EPC) is a method to implement energy efficiency projects, by which an ESCO (Energy Services Company) acts as a unique contractor and assures all of the steps of a project, from audit through installation up to operations and maintenance. The ESCO delivers a performance guarantee on the energy savings and takes responsibility for the end result. The EPC contract is the contractual agreement by which the output-drive results are agreed upon.
Crowdfunding	A crowd-funding involves an open call, mostly through the internet, for the provision of financial resources either in form of donation or in exchange for some form of reward and/or voting rights.
Revolving Fund	A fund established to finance a continuing cycle of investments through initial amounts received from its shareholders, creditors or donors and later on through amounts received from reimbursements of provided funding or loans to projects. These recoveredfunds become available for further reinvestment in other projects under the similar scope (e.g. revolving funds for sustainable energy will use the loans recovered funds to financenew sustainable energy projects.

5 Energy Performance Contracting

5.1 Overview of Energy Performance Contracting

Energy performance contracting, or EPC, is an innovative financing scheme offered by a contractor (usually ESCOs) to clients (e.g. a municipality) who require EE improvements but have limited financial means or technical capacities to implement such projects on their own. What makes EPC innovative is that an ESCO finances the project and implements energy efficiency investments, such as new control systems, system optimisation, and retrofitting of poles. A very common measure in public lighting is the replacement of an old street lighting system with LED technology, which often requires significant investments in advance. This obstacle can be overcome by EPC where technologies with short payback times are available. In EPC, pooling projects are recommended to increase the level of investment.

An ESCO (or any other EPC contractor) usually operates as a commercial entity regardless if it is owned by a public entity e.g. public utility company. It also serves as a general contractor that optimises the energy services systems and system operation by the means of construction and maintenance. ESCOs can provide the whole range of necessary energy services – from planning, management, implementation, and monitoring of energy management services and technical improvements. The ESCO shoulders the associated economic, technical, and administrative risks in carrying out the EE improvements. The ESCO must make sure that the equipment functions properly and be ready to replace any defective parts. This, of course, depends on the investment size and contract duration. The contract can also include how much time it may take until a defective part needs to be replaced (e.g. within three days). The main economic risk for ESCOs is not meeting the guaranteed energy savings which means reductions in EPC service fees. At the end of the contract, a maintenance contract can be developed where the ESCO continues maintaining the well-functioning system.

EPC can be classified into four models based on two elements: the distribution of modernisation works over time and the energy savings. Based on the latter element, EPC can be divided into a guaranteed savings model and a shared saving model. In this module, we focus more on the guaranteed savings model. The project is based on the guaranteed energy savings that will be generated in the future, which will be stated in the EPC contract. If the energy savings are lower than guaranteed, the ESCO must cover the shortfall. If the energy savings are higher, the client will take advantage of it entirely (Novikova,

Stelmakh, & Hessling, 2017). In principle, the ESCO plans and conducts the project and will only receive service fees – and get the return of investment – from the client using the savings in energy costs. The client eventually reaps benefits from energy and cost savings after the end of the contract. EPCs are usually long term with a contract of about 8 to 15 years depending on energy prices.

Moreover, the EPC model is flexible. It can be adapted according to the client's needs in various forms. Two core elements make EPC different from other types of financing schemes. Those are contractually guaranteed energy savings and financial consequences for the ESCO if the guaranteed savings are not achieved (Public Lighting - Replicable Practices | PROSPECT+ (h2020prospect.eu), https://h2020prospect.eu/replicable-practices/public-lighting)

- **Contractually guaranteed energy savings:** Through the analysis of the existing installation and the design of the new system, the client and ESCO agree to a certain level of energy savings that will be achieved;
- **Financial consequences for the ESCO if the guaranteed savings are not achieved.**

  Such consequences can take many different forms, e.g.:

a. Withholding or reduction of the payment to the ESCO according to a level of achieved savings.
b. A bank guarantee can be set up, enabling the client to draw this guarantee if the agreed savings are not achieved.
c. Retention of a percentage of the payment for the refurbishment work until an assessment shows the savings have been achieved over time.
d. The ESCO is required to adjust or replace the equipment until the savings are achieved.

Public lighting owners (e.g. municipality) with the support of local facilitators can design and plan an EPC project. In the initiation phase of the project, all concerned staff should take part in the process to make sure everyone involved agrees with the decision. They need to understand the business model and build trust in it.

Public lighting owners generally have low-to-medium economic risk levels. Should an ESCO fail to provide its services, a public lighting owner can withhold payments and penalties can be set. Even if the ESCO has designed and planned the EPC project and installed and operated equipment and technical facilities, the public lighting owner retains full ownership of the public lighting. As the ESCO is tasked to ensure the quality of the technical facilities from installation to operation, such as repairing defective parts, the public lighting owner should grant ESCO staff unconditional access.

However, the ESCO does not supply energy, so the public lighting owner should remain responsible to obtain the electricity from an energy supply company, for example. An experienced ESCO will try to include the existing staff from the public lighting owner (e.g. municipality's staff) and service providers (e.g. local electrician) to be in charge of the project. The tasks could be collecting data on the street lighting system, controlling the quality, implementing the measures, and revising the annual accounts.

Local facilitators can be local or regional energy agencies, engineering offices, legal advisers, architects, and economists. Facilitators should be knowledgeable and experienced in EPC concepts and business models, techniques and economics of EE in lighting, and public procedures and codes of conduct. Commercial facilitators can be contracted. However, standard service procurement procedures should be followed. Local energy agencies may be involved without tendering if financed by the membership fees of municipalities. Facilitators can assist in the preparation of EPC contracts, and in managing EPC tender procedures and contract negotiations. Consequently, facilitators have to consider the points of view of engineers (who sometimes overestimate the contractual challenges) as well those of financing

experts (who may tend to underestimate the technical delivery of the savings guarantee). Facilitators can also perform the energy audit to determine reliable numbers on saving potential as done in many cases of Streetlight-EPC projects.

Energy Performance Contracting has many advantages which include:

- The investment risks are transferred from the public lighting owner to the ESCO
- Usually no investment or up-front capital required from the business owner
- ESCO provides the required energy services which the public lighting owner benefits from
- ESCO provides guaranteed energy savings, which serve as a basis for their payments, assuring the client of the financial outcome of the project
- The maintenance of the public lighting system is taken care of by ESCO's professional services, so the expected savings are more likely to be achieved

5.2 EPC case studies

The following shows some case studies of public lighting projects.

Location: Municipality of Ribeira, Galicia, Spain

Project: Urban lighting renewal and CityTouch system integration

Results: In less than six months, the municipality replaced around 8,600 street lighting with LEDs and over 75% are controlled using a smart street lighting management system. With the help of an ESCO, Ferrovial Servicios, the municipalities paid no upfront project cost, as the ESCO covered the cost of the new lighting instalment and maintenance. The municipality would then pay back the ESCO monthly using the estimated 70% savings from the electricity bill. The project has successfully achieved the estimated cost saving and the municipality has received much less complaints on lighting faults from the citizens.

Source: Philips Public Lighting

Location: Municipality of Białowieża, Poland

Project: Enhancing a UNESCO World Heritage site with street lighting renewal

Results: Having a primeval forest, Białowieża attracts many tourists. The municipality wanted to keep a certain amount of darkness at night for the forest animals' needs, while at the same time facilitating the citizens and tourist traffic with energy-efficient lighting. The municipality refurbished its public lightingand implemented Philips's CityTouch lighting management system that remotely allows easy control and adjustment of the lighting. The project was partly funded by Poland's SOWA programme, a large-scale green investment scheme that supports EE projects in public lighting. This project was funded by a subsidy and a loan. With approximately 77% energy saved as a result of this project, the municipality has saved PLN 150,000 (over €34,000) per year.

Source: Philips Public Lighting

Location: Municipality of Rainbach, Upper Austria

Project: Street lighting project under Upper Austrian EGEM programme

Results: This 10-year project aimed to replace the old street lighting to LED technology for EE improvement. The municipality decided to use EPC after consulting with a lighting planner. More than half of the investment cost was financed by the EPC project. The municipality also obtained subsidies through regional contracting programme and environmental subsidy. This project resulted a significant guaranteed maintenance cost savings. Over 70% of the savings were guaranteed by Linz AG, the ESCO of the project. The total number of lamps used after renovation is only 27% of the total number before renovation. The annual electricity cost was cut down to 58%.

Source: STREETLIGHT EPC Project

5.3 How can energy savings be guaranteed?

First, the ESCO and public lighting owner set the baseline energy consumption of the lighting before EPC. This can be based on the energy consumption costs before EPC (the reference year), such as, for example, the energy cost paid by a public lighting owner at a specific time of the reference year (e.g. € 100 on December 31, 2016). However, these can be adjusted based on various factors. Factors that are unmanageable by the ESCO, such as energy prices and changes in operation times, will be overcome by comparing the energy costs and energy consumption levels to those of the reference year.

Using the baseline energy consumption, the ESCO can calculate and guarantee annual energy cost savings to the public lighting owner throughout the contract period. Both ESCO and public lighting owners will establish how to evaluate and verify the energy savings. The ESCO ensures that the energy savings will be achieved, while the public lighting owner guarantees the payment of EPC service fees to the ESCO.

The ESCO provides energy reports and energy savings records. It should also be transparent in the adjustments of technical parameters, such as the use and conditions of the lighting or in the installation and removal of energy devices. Usually, the ESCO conducts periodic metering of consumption using automated systems or by remote access and control. However, it is advised that the staff of the public lighting owner keep track of the savings and verify them regularly. The staff should be competent to check the progress, evaluate and suggest relevant corrective action.

5.4 Financing sources for EPC

One of the main hindrances to implementing EPC projects is the lack of capital to fund the project. According to OÖ Energiesparverband in the publication of Advanced LED EPC models, *"with the financial crises, (pre-) financing for energy efficiency investments has become increasingly burdensome for ESCOs and their customers, especially if they reach their credit lines, credit liabilities and fixed assets burden balance sheets."* Therefore, choosing the right financing scheme is crucial.

Some aspects should be taken into consideration:

- Direct financing cost (financing conditions, interest rates, fees, etc.)
- Legal aspects (rights and duties, ownership, contract cancellation, etc.)
- Required collateral (securities) by the financing institution

- Taxation implications (VAT and purchase tax, corporate income tax, etc.)
- Balance sheet and accounting implications (who activates the investment, balance sheet effects like credit lines, performance indicators, Maastricht criteria, etc.)
- Management expenditure (transaction cost, comprehensive consultancy, etc.)

Credit financing

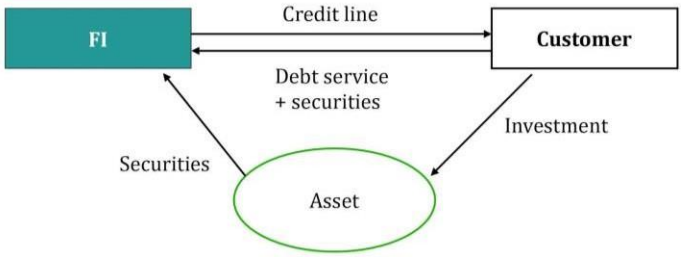
Credit (or loan) financing in general is a financial model under which a financing institution (FI) lends a borrower (customer, in our case it can be an ESCO) capital for a certain purpose over a period of time that is set in the agreement. The borrower has to pay back the loan within a fixed period of time with additional interest rates and other transaction costs, such as administrative ones. As long as there is a proof of purchase, the loans are reimbursed to prevent financial abuse.

The borrower must be creditworthy. To increase the chance of getting the loan from an FI, the borrower should be connected to "BASEL II". It means that the borrower is assessed by international standard criteria that determine the level of the borrower's creditworthiness.

The following figures depict types of credit financing scheme based on the European Energy Service Initiative (EESI):

a. A credit financing scheme typically provides the customer a credit from an FI that will be returned with extra costs as debt service and securities. The securities serve as a guarantee to cover the risk of the FI as depicted in the following figure.

Figure 2: Credit financing - General Scheme



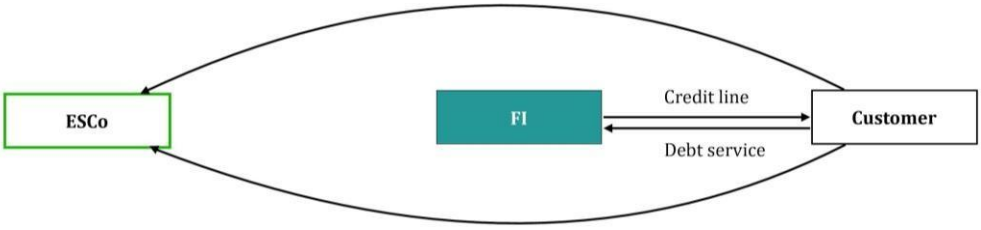
b. Credit financing can also form a basic cash flow relationship, where the ESCO lends the credit, as shown in the following figure (figure 6). The ESCO is in charge of refinancing the credit line for investment as well as implementing energy efficiency measures. The contracting rate that is paid by the customer can be used by the ESCO to perform the debt service. This type of scheme is called "traditional" ESCO-Third-Party-Financing.

Figure 3: Credit financing - cash flow in EC projects with ESCO financing

c. In some cases, the customer can be the lender of the credit, which is shown in the following figure. The implementation of the energy efficiency measures by the ESCO is funded by the customer from their credit line, subsidies, or maintenance reserve funds. This type of credit

financing scheme, also called the Operation-management-EPC model, is recommended if the customer has better financial conditions than the ESCO.

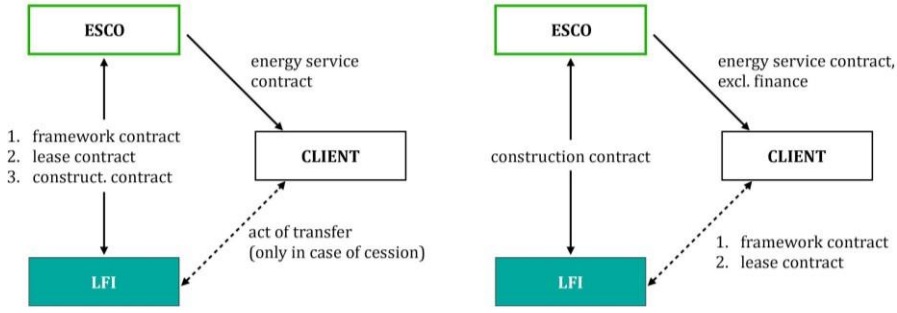
Figure 4: Credit financing - cash flow in EC project with customer finance



Lease financing

To use an asset without having the right to own it can be done through leasing. Assets in our case mean investments into EE measures. According to EESI, *"leasing is a contract between the owner of the asset (lessor) and the user (lessee), wherein the former grants exclusive rights to use the assets for a certain period (basic lease term), in return for payment of a lease. The lease is typically paid in annuities to the leasing finance institute (LFI)."* The lessee can be either an ESCO or the client (public lighting owner) which is depicted in Figure 8 below.

Figure 5: Contract relationship of a leasing agreement with ESCO (left) or Client (right)



According to ESSI, *"the LFI takes over financial and administrative services and risks and concludes a framework and lease contract either with the ESCO (sometimes including a cession agreement for a part of the contracting rate) or with the client. The LFI signs a construction contract for the EE investments with the ESCO."*

Cession and forfaiting of contracting rates

In another model, the ESCO acts as a cedent[2] and a FI acts as a buyer. This is called cession, where the ESCO hands over the contracting rates, which are paid by the ESCO's client, to the FI. The FI takes over the ESCO's right to claim the contracting rates in the future.

There are two kinds of cession:

a. **Cession**: A cession can be included in credit or lease financing. The contracting rates that are handed over to the FI can be used as (additional) security or guarantee for the FI.The ESCO's client can directly pay all or parts of the contracting rates to the FI as agreed.

[2] A cedent is a party in an insurance/guarantee contract who transfers its right to the insurer/guarantor (in our case is FI) for certain potential losses.

b. **Forfaiting**: A cession that is implemented without a financing agreement (credit ofleasing) beforehand is called forfaiting. The FI takes over the contracting rates and pays the discounted present value one time directly to the ESCO.

Further financing sources

In most EPC projects, the ESCO is mainly the investor and financer. Other financing sources are usually not necessary for EPC projects that require low investments. In many cases, an investment of several ten thousand Euros is the minimum size of investment for an EPC project, otherwise, the cost of preparing the project (including setting up the contract) represents too large of a proportion of the savings. However, this strongly depends on the specific circumstances.

EPC has also been used for rather small projects. In some cases, it can be useful to combine several smaller projects to achieve the threshold investment level. However, big projects, such as extending the street lighting system, cannot usually be financed by the savings, hence the client may make use of other financing sources. These include subsidies on specific technical measures and on interest rates paid by the ESCO reducing financing costs, or feed-in tariffs for power generated from renewables or in combined heat and power plans.

5.5 Setting up EPC

5.5.1 Business models for EPC

There are various business models for EPC reported by the Streetlight-EPC project. These business models may have overlaps as projects may mix different features.

EPC Basic

EPC Basic is the most common EPC business model that aims to facilitate investments in fast- paying EE improvements or those that can generate high energy-saving effects. The ESCO will take on the liability of (most of) the related risks, including the operating risk, as they are responsible for operation and maintenance. The client pays the service fee that is calculated based on the prior state and the EE improvements as agreed in the contract. It is not necessary for the client to understand deep technical knowledge within the administration as it will be done by an external specialist. However, the client must acknowledge that the ESCO will obtain most of the energy savings achieved throughout the duration of the contract as a repayment of the investments made.

EPC Light

In this business model, the ESCO is contracted to optimize technical facilities to facilitate EE. However, EE improvements are realized with little to no investment in technical facilities. This model is perfect for the public lighting owner that has no sufficient capital and staff to undertake adequate energy management. As an external energy manager, the ESCO offers some measures to optimize the energy-related installations. The measures can range from energy management system improvements, lighting control improvement, sensor installations in certain areas that can generate high potential savings, to lamp replacements. The contract duration can be adjusted based on the needs and is typically short in period, from two to three years.

EPC and subsidy

As the name suggests, this advanced EPC model is supported by a subsidy scheme for ESCOs, integrating construction measures with the installation of high-efficiency equipment. This will result in major synergy effects when the project is undertaken efficiently, hence cutting the energy consumption optimally. However, in some regions, an ESCO cannot take the subsidy, but only the client.

Integrated Energy Contracting

This model is a combination of Energy Supply Contracting (ESC) with energy efficiency measures, which are offered by EPC, including minor measures for comprehensive refurbishment. In ESC, an ESCO is also an energy supplier that earns profits from selling energy to the client. The integrated energy contracting model aims to lower energy consumption by applying energy efficiency improvements, such as lamp substitution to LED technology. The model also intends to use energy supply from renewable energy sources.

EPC contracting with Code of Conduct

A signature of the Code of Conduct can act as a compass for EPC projects. If an ESCO adheres to the Code of Conduct, it can ensure the quality of EPC projects. The ESCO will gain the trust of potential clients, so they are more likely to use the ESCO's service. Some projects that used the Code of Conduct can be found in http://www.transparense.eu/.

Lighting manufacturers offer ESCO services

As an approach to direct sales of streetlight products, some lighting manufacturers provide ESCO services. They are responsible for the technical and financing risks that may occur, as they provide the energy services themselves. This attracts the potential customers to purchase their products.

EPC contracting with capital from National Funds

The EPC market is newly developed in some countries across the EU. As a result, it is reasonably difficult to find any ESCOs in the country. Conducting EPC projects needs support from the national government

both financially and technically. The government could make use of national funds for energy efficiency. The government could also obligate energy savings by contract to a municipality.

Combine EPC for street lighting and other facilities

EPC for street lighting might be less viable due to the size of the project. To reach the minimum investment threshold, the project can also integrate other facilities in the contract. Possible combinations could be street lighting and public buildings and/or indoor lighting of buildings and/or facade lighting.

EPC and detailed energy audit cost

At the beginning of an EPC project, it is important to perform a thorough energy audit to assess the viability of the project. It is also needed to arrange the tendering process for ESCO. However, it could be a challenge to get the audit done comprehensively, especially when the inventory of the street lighting system is lacking or inadequate. It could cost a significant amount of money. To overcome this barrier, an advanced EPC model can be developed where the ESCO also performs the energy audit. The audit cost will be included in the EPC contract if both parties (the ESCO and the client) agree to proceed further after the audit results. Otherwise, the client will pay the energy audit cost to the ESCO.

5.5.2 Common incentives and barriers for EPC

The development of EPC is facilitated by the following:

- EPC guidelines, tools and sample contracts available in the country (or under preparation)
- National or regional databases of ESCOs and facilitators
- National and regional competence centres promoting EPC
- Promotion of inter-municipal cooperation and/or pooling of public lighting in EPC projects
- Trade associations of ESCOs promoting EPC as a business model
- Regional and local energy agencies and/or associations of local authorities promoting and facilitating EPC

Political and legal incentives

- High political commitment to EE and economical energy savings at the national level
- National EE law and supporting laws promoting EE
- Promotion of EPC as an innovative EE service in regional and national programmes and policies

Economic

- The expectation of increasing energy prices
- Energy-saving insurances for new ESCO
- Feed-in tariffs for renewable energies

Financial

- Limited municipal budgets increase the interest in EPC as a financing model
- Subsidies for municipal EE programmes and projects (planning and implementation)

However, certain conditions pose barriers to the development of energy performance contracting:

Political and legal

- Procurement rules and procedures for public authorities (complex tendering procedures)
- Budget and accounting rules for local public authorities
- Restrictive regulations for financing cooperation of public authorities with the private sector
- Little interest in EPC as a financing tool among municipal decision-makers
- Requirements concerning the comparison of EPC and clients' own investment

Administrative

- Lack of understanding of the EPC concept among municipal decision-makers and initiatives
- Lack of qualified and motivated personnel in some public administrations or public services
- Non-transparent, lengthy, or complex decision-making processes in municipalities
- Competition between investments in EE and investments in other public services
- Distributed responsibility for energy bills, maintenance and operation of facilities in municipal administrations
- Lack of finance and/or personal capacities for project preparation, tendering, contract negotiation

Economic

- Risk of incorrect calculation of baseline consumption
- Decreasing energy prices for fossil fuels
- Feasibility of EPC only for bigger projects that can achieve minimum investment threshold

Financial

- Limited or lacking public funding and limited (or no) access to loans by municipalities
- Lack of collaterals
- High cost of loans
- High planning and bidding cost
- Limited access of ESCOs to bank loans

Technical

- Lack of experience in the calculation of baseline consumption
- Lack of attractive good practice examples in the country
- Lack of know-how and experience among local public utilities
- Lack of calculation tools and sample contracts
- Lack of qualified local facilitators promoting EPC projects
- Lack of local ESCOs offering EPC services

Other barriers

- Bad reputation of EPC and ESCOs among public administrations and decision-makers
- High barriers for the market entrance of new ESCOs

- Lack of information on EPC in public lighting

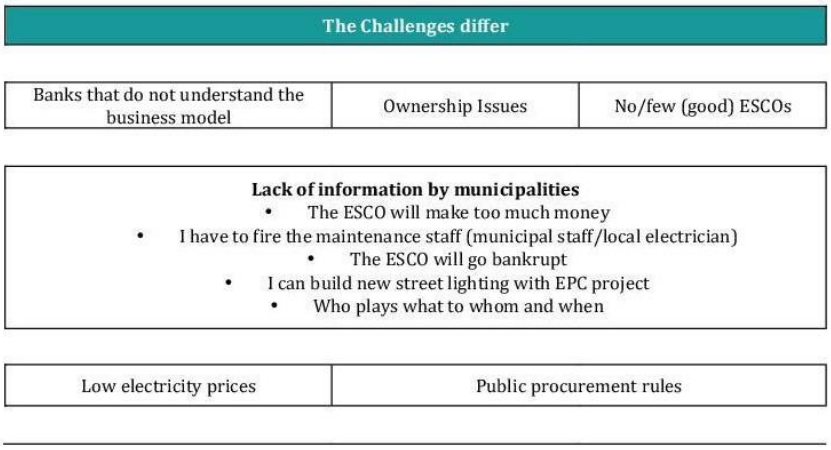
Would you like to know more incentives and barriers – and whether these apply to your country or not? Take a look at these incentives and barriers across nine (9) European countries from EnPC– INTRANS Project.

5.5.3 Challenges and solutions in EPC projects

Challenges might differ in each region based on the economic, regulatory, and institutional circumstances. The low energy prices in Eastern European countries result in longer payback periods, which hinder ESCOs from undertaking the EPC projects. There are cases where municipalities wanted to implement EPC, but no qualified ESCOs could be found on the market. In other cases, ESCOs were trying to offer services like EPC to municipalities, but the lack of trust from the side of municipalities hindered the implementation of EPC. This could be due to the municipalities being ill-informed of EPC. Another challenge is the lack of incentives from the side of contractors (e.g. ESCOs) to increase energy savings beyond the savings stated in the contract. This can be solved in EPC – the shared savings model, where both parties benefit from the additional energy savings.

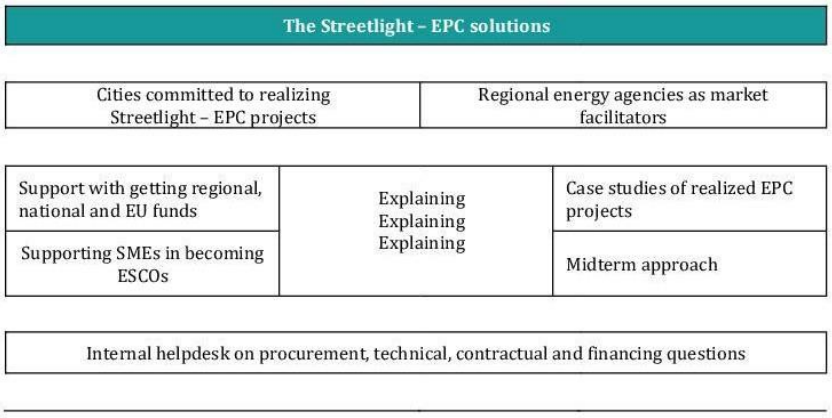
The following figure illustrates the challenges in implementing EPC that were encountered during the Streetlight-EPC project.

Figure 6: Challenges in EPC projects



Based on these challenges, here are the solutions identified by the Streetlight EPC project. Some challenges can be addressed with the help of market facilitators and some others need interventions from political and legislative sides on regional, national, and EU levels.

Figure 7: Solutions in EPC Projects



5.5.4 Guidelines for managing EPC projects

The EPC Code of Conduct promotes a professional and transparent approach to managing EPC projects. There are nine (9) guiding principles:

1. The EPC provider delivers economically efficient savings
2. The EPC provider takes over the performance risks
3. Savings are guaranteed by the EPC provider and determined by M&V
4. The EPC provider supports long term use of energy management
5. The relationship between the EPC provider and the client is long-term, fair and transparent
6. All steps in the process of the EPC project are conducted lawfully and with integrity
7. The EPC provider supports the client in the financing of the EPC project
8. The EPC provider ensures qualified staff for the EPC project implementation
9. The EPC provider focuses on high-quality and care in all phases of the project implementation

Learn more about the EPC Code of Conduct from TRANSPARENSE http://www.transparense.eu/.

5.5.5 Developing energy performance contracting for public lighting

The project development consists of five steps according to the Streetlight-EPC project. The following table presents the general steps of a lighting refurbishment project with EPC. The steps and order may vary depending on the project and regional context.

Table 3: Steps in project development

Data collection • Analysis of the current state of the lighting system • Identification of priority refurbishment areas • Data collection (luminaires/lamps, light poles, etc.)
Definition of quality and procurement criteria • How much light is required/desired? Which colours? • Expected service life • Which control system (dimming, reduction during the night, etc.)? • Maintenance costs • Other criteria for technology solutions
Detailed analysis of investment costs & savings • Development of the baseline • Identification of potential public support
Tendering & selection of ESCO • Tendering (based on criteria defined above) • Identification of potential ESCOs • Development of EPC contract
Implementation • Implementation & tracking results • Accounting

The facilitators can support each step of the project development. At the step of **data collection**, the public lighting owner (e.g. municipality) can discuss the data with the facilitator to get a piece of advice on the next phases. Some checklists that were created by the Streetlight-EPC project can be used and be found on the website (http://www.streetlight-epc.eu/fileadmin/redakteure/Streetlight-EPC/Project_outputs/WP2/Quick_check/Quick_check_street_lighting-European-EN.pdf). The checklists also contain an initial general evaluation to assess the economic viability of a public lighting refurbishment with EPC.

At the step of the **definition of quality and procurement criteria**, it is important to understand which LED technology can be suitable for the needs of public lighting. A facilitator that is highly knowledgeable about LED technology for public lighting can help set the criteria and compare different offers at the tendering stage. A summary of important aspects to know before converting to LED technology can be found in the **Toolbox**.

The facilitators can give technical and financial advice at the step of **detailed analysis of investment costs and savings**, minimizing the risk of inaccurate calculation of baseline consumption. The facilitators can offer a list of ESCOs at the step of **tendering and selection of ESCO**. At the step of **implementation**, the facilitators can communicate results and findings to other cities.

The municipality and the ESCO would engage in a public-private cooperation – formalized by a contract with the following key elements as outlined in the Energy Performance Contracting Manual (TRANSPARENSE Project, https://www.transparense.eu/eu/#:~:text=The%20goal%20of%20the%20Transparense%20project

%20was%20to,of%20Energy%20Performance%20Contracting%20%28EPC%29%20markets%20throughout%20Europe):

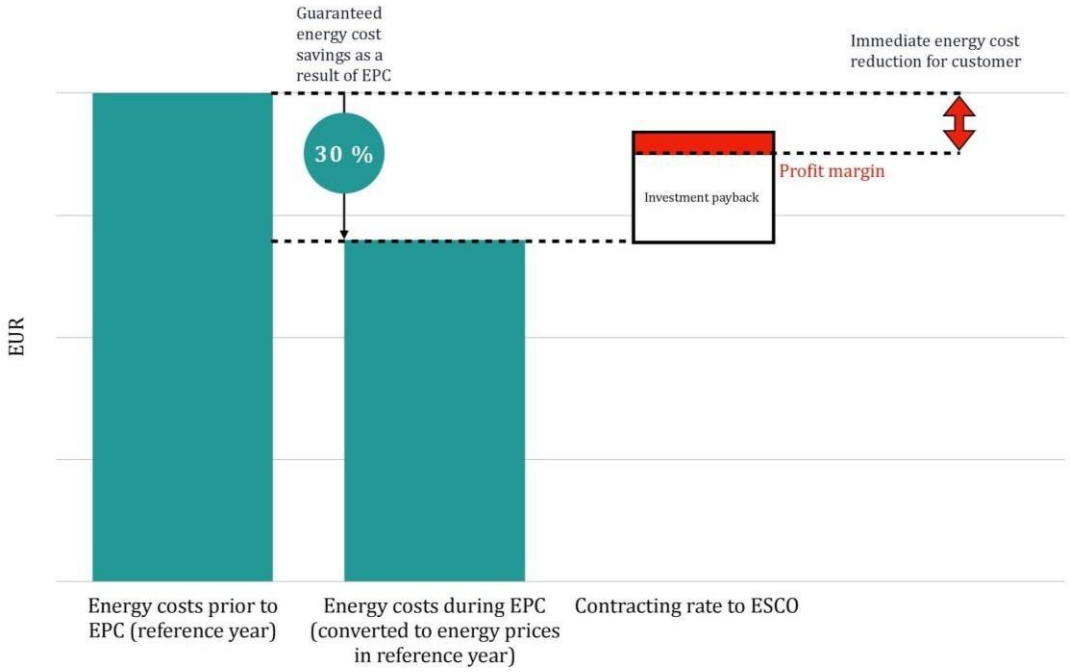
- The ESCO guarantees a certain amount of yearly savings (**guarantee of savings**) to be achieved throughout the duration of the contract;
- The **volume of investment** to bring the guaranteed savings and a commitment by the client to pay the investment after its installation;
- Clear **definition of a reference scenario** (baseline) of the future energy consumption;
- The obligation of the ESCO to provide a **report on yearly savings evaluation** that documents the actual amount of achieved savings in the respective year;
- Responsibility of the ESCO for correct **design and implementation of the energy-saving measures;**
- The obligation of the client to provide pre-agreed **conditions for the implementation** of the energy-saving measures;
- The planned **duration of installation** of the investment;
- **Ownership transfer** of the installed energy-saving technologies to the client;
- **Means of payment** for the services and savings;
- Declaration of the **purpose of operation of the facility** which the contract covers;
- Length of the contract;
- **Method of recalculation** of the guaranteed savings in case any of the input parameters differs from the presumptions defined in the reference (baseline) energy consumption scenario;
- **Final report** – before the end of the paying-off period the ESCO hands over to the client the final report including the total amount of cost savings, guaranteed savings, given reduction in the price and bonuses calculated for the entire paying-off period, etc.

5.5.6 Calculating EPC service fees

A fixed proportion of the guaranteed savings will be the EPC service fee which the ESCO gets from the public lighting owner to attain a profit margin and maintain the installations. The remaining proportion can be kept by the public lighting owner or shared between the EPC and the owner to motivate the ESCO for achieving additional savings. The yearly EPC service fee remains constant throughout the duration of the contract. The EPC contract is not affected by rising energy prices because it uses the energy costs in a baseline year, although the rising energy prices will surely affect the client's energy bills. In addition, an increase in energy demand is not covered by the EPC, unless it is specifically stated so.

The service fees for EPC are calculated to ensure repayment of all costs of the ESCO as well as the expected return of investment. However, the fees should not go beyond the value of the guaranteed savings in the baseline year. Figure 2 shows the relationship between the EPC service fee and energy costs. In this case, the annual guaranteed savings are 30% of the energy costs in the baseline year, while the ESCO service fee is set to be 80% of the guaranteed savings during the contract period. The payment can be received either partially or in whole, depending on the agreement. Likewise, the payment scheme can be arranged.

Figure 8: EPC service fee and energy costs in EPC arrangements



Source: GIZ 2013

5.5.7 Key lessons learnt from EPC projects and recommendations for implementation

EPC model

- A wide range of EPC models shows how versatile EPC is. It is adjustable in any particular setting, from legal, economic to social ones, of each region and project.
- The hindrances that each region encounters in establishing the EPC project are different, such as the shortage of ESCOs, proprietary rights, and specific procurement rules. Thus, finding an appropriate EPC model is one of the solutions besides mediating with the facilitator and political and legislative authorities.
- The essential features that must be included in every EPC model are contractually guaranteed savings and financial consequences for the ESCO if the savings are not achieved.

Contract and finance

- The bundling of street lighting systems and other facilities in one EPC project helps in decreasing transaction costs and creating economies of scale. Small and uncomplicated projects are more suitable to urge SMEs to take part in the ESCO market.
- Available subsidies and grants should be used and included in the financial concept of an EPC project.
- A neutral and qualified third party acting as an arbitrary should be nominated in the contract and its decisions acknowledged as binding by both parties.
- Financing options for EPC projects
    - Very good experience exists with financing by EE Funds

- Additional financing by the public lighting owner (e.g. municipality) can be helpful for the financing of the EPC
- Insurances for the calculation of savings are an appropriate instrument to mitigate the risks for ESCOs, in particular for new un-experienced ESCOs.

Facilitator

- Most of the public lighting owners (e.g. municipality) rely on proficient facilitators in
  - Project planning and preparation
  - Investigation and activation of potential grants and subsidies from regional, national and EU sources
  - Compilation of tender documents and assistance with the tendering process
  - Tender evaluation and contract negotiations
  - Quality control of provided installations and services
  - Measurement and verification of achieved savings
  - Checks and approvals of EPC bills
  - Verification of possible financing instruments (soft loans, instruments and grants)
- The capacity development of local facilitators is, therefore, a priority for the development of local capacities for EPC in public lighting
- Facilitators must guide the staff from the public lighting owner through every phase of the project, ensuring the staff get a grip on the project

ESCOs

- For new ESCOs, access to the EPC market is connected with high economic and administrative barriers
  - Economic and technical risks are rated high by most of the interested clients
  - New ESCOs usually have to provide additional bank guarantees or insurancewhich increases the cost
- ESCO needs to understand the technical, contractual and economic aspects thoroughly, so the client can trust the ESCO and the EPC model they provide.
- In the tendering process, the ESCO should be selected based on the performance, not the lowest price offered

Process

- To achieve a favourable outcome, it is important to have a good technical project preparation, such as an accurate and significant inventory of the public lighting system as well as a good-quality audit to help specify the reasonable guaranteed savings
- Monitoring and verification of guaranteed savings are often complex and may lead to debates between the ESCO and the client
- Adjustments may be required regularly, depending on, for example:
  - Weather conditions
  - Changes in consumer behaviour
  - Type, intensity, and frequency of lighting use

- Installation of additional, or removal of old consumer device
- Replacement of old consumer devices with new, more energy-efficient devices
- Changes in lighting pole (retrofitting) and of installed facilities

- Simplified measurement and verification methods as well as key performance indicators, if agreed upon by both parties in advance, may help to reduce both complexities of calculations, and reasons for debate

Source: EnPC – INTRANS and Streetlight-EPC Project Publication

Here are some recommendations for implementing EPC projects from the STREETLIGHT EPC Project:

- Good technical project preparation is key. EPC is a long-lasting partnership – the right approach in project preparation is therefore key for the success of the project
- LED: offers choice, requires knowing your needs. LED solutions are proven technologies that are suitable for very small and very large projects and that permit high-energy savings at high lighting comfort levels.
- Better projects through EPC. If the right approach is taken, EPC supports solutions with a higher level of technical quality than would have otherwise been chosen.
- Small is (also) beautiful. To profit from European financing mechanisms, projects need multiple-million level investments. Also, in principle, specific transaction costs concerning savings decrease with the project size, making more projects economically viable.

5.6 Toolbox and Materials

- Guide to Streetlight Refurbishment with Energy Performance Contracting
- Checklist for Streetlight Refurbishment with Energy performance contracting
- Quick check lighting refurbishments: hall
- Quick check lighting refurbishment: outdoor parking
- Policy recommendations from the STREETLIGHT EPC Project
- How to implement smart street lighting
- Real-life examples of Siemens's intelligent street lighting

5.7 Related Projects

- **Streetlight-EPC:** Creating demand and supply for EPC street lighting refurbishmentprojects in 9 regions in Europe by setting up regional EPC facilitation services
- **PARIDE:** Province of Teramo (Italy) provides technical assistance to accelerate the implementation of tangible investments in energy efficiency in the street lighting sector
- **ICP Europe Protocols:** Increasing confidence in project performance while reducing due diligence-related transaction costs, one of the focuses is street lighting
- **DYNAMIC Light:** Towards, dynamic, intelligent and energy-efficient public lighting
- **TRANSPARENSE:** Increasing Transparency of Energy service markets
- **EnPC Intrans:** Capacity building on energy performance contracting

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PROSPECT+

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