GUIDELINE ON FINDING A SUITABLE FINANCING MODEL FOR PUBLIC LIGHTING INVESTMENT

Deliverable D.T2.3.3 Best practice guide

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DYNAMIC LIGHT

Project description

The Dynamic Light project aims to demonstrate the importance of providing light under a variety of circumstances and to examine who uses lighting at what time and for how long. The project explores strategies for introducing energy-efficient lighting in urban areas and identifies the steps required to translate strategies into action, from the initial idea through the analysis, geographic information system data mining, strategy development, financial modelling, procurement process, implementation and evaluation. These strategies are intended to facilitate investment in pilot and demonstration projects that bolster acceptance of energy-efficient lighting among end-users and urban planners by improving the quality of dynamic light and adapting it to social needs. The project examines the implementation of public lighting under conditions typical of European municipalities.

Consortium

Hochschule Wismar	DE	Ernst-Moritz-Arndt-Universität Greifswald	DE
BSC, Poslovno podporni center d.o.o. Kranj	SL	SWARCO V.S.M. GmbH	DE
PORSENNA o.p.s.	CZ	Grad Čakovec	CR
Međimurska energetska agencija d.o.o.	CR	Deutsche Lichttechnische Gesellschaft e.V.	DE
Comune di Cesena	IT	Poltegor-Instytut, Instytut Górnictwa Odkrywkowego	PL
TEA SpA	IT	Hansestadt Rostock	DE
Fondazione Bruno Kessler	IT		
Spath MicroElectroni cDesign GmbH	AT		

Associated partner

Institute for Climate Protection, Energy and Mobility (IKEM) DE

GUIDELINE ON FINDING A SUITABLE FINANCING MODEL FOR PUBLIC LIGHTING INVESTMENT: DELIVERABLE D.T2.3.3 – BEST PRACTICE GUIDE

Investment in energy efficiency upgrades of street lighting infrastructure provides high energy savings and reduces carbon dioxide emissions. It is also very cost-effective and has a short payback period. In spite of these advantages, a large share of the infrastructure in many Central European countries requires refurbishment. The lack of investment in this area is often explained as a result of budgetary constraints on infrastructure owners, many of which are municipalities. Such concerns must be addressed through the development of creative business models that can attract other investors and reduce the high upfront costs that discourage investment. This report reviews existing financing models, including self-financing, debt-financing, financing by a private contractor, financing by a private contractor, through energy savings, financing by public-private partnerships, financing by utilities, and financing by citizens. For each model, we provide an overview, identify the projects to which it can be applied, specify its advantages and disadvantages, and provide a relevant case study.

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Acronyms and abbreviations

CO_2	Carbon dioxide
CEB	Council of Europe Development Bank
DIN	Deutsches Institut für Normierung [German Institute for Standardization]
DIPH	Diputación Provincial de Huelva [Provincial Council of Huelva]
EC	European Commission
EBRD	European Bank for Reconstruction and Development
ED	Energiefonds Den Haag [Energy Fund The Hague]
eeef	European Energy Efficiency Fund
EEO	Energy efficiency obligation
EIB	European Investment Bank
ELENA	European Local Energy Assistance
ENEF	Lithuanian Energy Efficiency Fund
ENIGMA	Enlightenment and innovation, ensured through pre-commercial procurement in cities
ERDF	European Regional Development Fund
EPC	Energy performance contracting
EPRP	Energy performance-related payment
ESCO	Energy service company
ESF	Energy Saving Fund
ESIF	European Structural and Investment Funds
EU	European Union
HEID	Holdingfonds Economische Investeringen Den Haag [Holding Fund for Economic Investment The Hague]
HPM	High-pressure mercury (lamps)
FEF	Foresight Environmental Fund
FRED	Fonds Ruimte en Economie Den Haag [Fund for Urban Space and Economy The Hague (Urban Development Fund)]
JESSICA	Joint European Support for Sustainable Investment in City Areas
GHG	Greenhouse gas emissions
GLA	Greater London Authority
GSHF	Greener Social Housing Fund
HPM	High-pressure mercury
HPS	High-pressure sodium
INPP	International Public Partnerships
LED	Light-emitting diode

LEEF	London Energy Efficiency Fund
LGF	London Green Fund
LWARB	London Waste and Recycling Board
KfW	Kreditanstalt für Wiederaufbau [Reconstruction Credit Institute]
NGO	Non-governmental organisation
PPP	Public-private partnerships
QECB	Qualified energy conservation bond
SEIA	Sustainable Energy Authority of Ireland
SEAP	Sustainable Energy Action Plan
SPV	Special-purpose vehicle
SWF	Sovereign wealth funds
UDF	Urban development funds
UK	United Kingdom
VIPA	Lithuanian Public Investment Development Agency

Terms and definitions

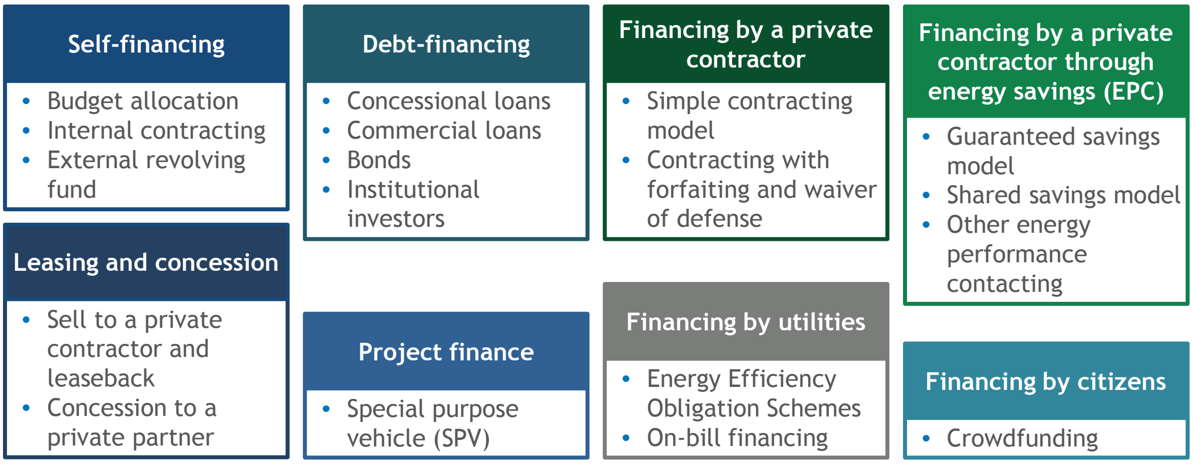
Term	Definition	Source
Blending	Ability to combine financing with additional sources of investment, such as guarantees, trust funds, and project bonds.	(EIB 2017a)
Debt finance	Lending money to a company, government, or project in the form of a loan or bond.	(Reyes 2012)
Equity	A stock or any other security representing an ownership interest or partial ownership of a company. The value of the investment is related to the success, rather than the interest payments accrued by debt finance.	(Reyes 2012)
Forfaiting loan	A financing method whereby a bank advances cash to the contractor against invoices or a promissory note guaranteed by the city. The term is used primarily in international trade of capital goods.	Own definition
Grant	Transfers made in goods, cash, or services from a government or other organisation to an eligible recipient for a specified purpose, with no repayment required.	(OECD 2001)
Guarantee	A written commitment to cover risks for all or part of a third party's debt, obligation, or loan portfolios in order to provide potential economic and regulatory capital relief.	(European Structural and Investment Funds 2014)
Institutional investor	An institution that manages and invests other people's money. Examples: pension funds, insurance funds, investment funds, and other entities on the capital market.	(OECD 2014)
Leasing structure	Renting of an asset for an agreed period of time as an alternative to outright purchase.	(OECD 2001)
Loan	The act of giving an agreed sum of money to another party in exchange for future repayment of the principal amount, along with interest or other finance charges, within an agreed period of time.	(European Structural and Investment Funds 2014)
Microcredit	Provision of thrift, credit, and other financial services and products of very small amounts to low-income individuals in rural, semi-urban, and urban areas in order to raise income levels and improve living standards.	(College of Agricultural Banking n.d.)
Mezzanine financing	A hybrid of debt and equity financing that gives the lender the right to convert to an ownership or equity interest in the company in case of default. Mezzanine debt may take the form of debt, senior subordinated debt or private, 'mezzanine' securities.	(Silbernagel and Vaitkunas n.d.)
Senior debt	Debt that is repaid before other claims in the event of liquidation.	(World Bank 1991)
Subordinated debt	The opposite of senior debt; it is repaid only after payments on other obligations have been made. Also referred to as 'junior debt'.	(World Bank 1991)
Venture capital	Financing provided in the form of capital investment for a new business or for product development, often in exchange for equity.	(OECD n.d.)

Executive summary

Upgrading street lighting infrastructure is cost-effective and increases energy efficiency, but upgrade rates are low in many jurisdictions in Central Europe. For municipalities and municipally-owned companies, high upfront costs are among the greatest barriers to investment in street lighting upgrades. Overcoming this obstacle requires the development of creative financing models that will attract private investors.

This report provides an extensive overview and analysis of the models used to finance upgrades of urban street lighting infrastructure. The models addressed here include various methods of self-financing, debt-financing, self-financing, debt-financing, financing by a private contractor, financing by a private contractor through energy savings, financing by public-private partnerships, financing by utilities, and financing by citizens (Figure 1). We describe the key design features of each model, specify its advantages and disadvantages, identify the projects for which it is best suited and provides a case study. Figure 2 provides a summary of key findings.

Figure 1: Financing models for public street lighting investment



Source: Authors' own figure.

The suitability of a financing option depends, in part, on its specific advantages and disadvantages, as well as on the existing economic, market and legal conditions. For example, off-balance-sheet financing of street lighting upgrades reduces the burden on municipal budgets, but is contingent on project size and cash flows and may result in a loss of full project ownership and increase the complexity of project implementation. Therefore, the appropriateness of a model will depend on the specific characteristics of the municipality. Some of the key considerations in choosing a financing model are the availability of own resources; the municipality's borrowing capacity, project size and bankability; the maturity of the market of energy service providers and energy service companies (ESCOs); and, finally, policies at European Union (EU), national and sub-national levels and financial incentives.

Self-financing. In the most straightforward financing model, street lighting upgrades are paid for from own funds of municipalities or through grants available from national or EU programmes. To minimise the burden on taxpayers, the public sector can help raise funds by designing and implementing additional schemes (for example, an internal performance contracting or designated revolving fund).

Debt-financing. Many municipalities with limited own funds issue debt, which is then paid back from the tax revenue of municipalities and/or saved energy costs. Municipalities can issue municipal bonds or obtain a concessional loan from available public lending programmes or a commercial loan from a commercial bank.

Financing by a private contractor. The alternative is to reallocate to third parties the burden of financing street lighting infrastructure, for example by entering into an agreement with an energy service contractor. There is wide variation among such contracts. In a simple contracting model, the contractor directly receives a contracting fee, which covers the costs of planning, financing and executing the infrastructure retrofit, including the margin. In a more complex model with forfaiting and waiver of defence, the roles played by the city and the contractor are similar to those under the simple contracting model, but a bank enters into agreements with the contractor and the city.

Financing through energy savings. The other configuration is energy performance contracting (EPC) models, which may be implemented when the municipality or contracted party pays for its energy supply. In this model, the energy costs saved by reducing consumption are used to finance the street lighting retrofit. Typically, the contracted energy service company guarantees a certain level of energy savings. In shared savings EPC models, additional energy savings achieved on top of the guaranteed level are shared between the municipality and the contractor.

Leasing or concession to a private partner. Leasing models are also used to finance street lighting upgrades. Leasing entails the sale of street lighting infrastructure ownership rights by a municipality to a private contractor, conditional on the contractor's upgrade, operation, and management of that infrastructure. The municipality than leases it from a private contractor for a fixed fee over a set period, after which the ownership rights are transferred back to the municipality. In the case of a concession contract, a private partner is granted rights to operate and maintain street lighting and accrues all benefits resulting from the energy efficiency upgrades.

Project finance. Project finance is often used to raise private capital for large bankable projects with capital costs over approximately €20m. In this model, a special-purpose vehicle (SPV) is established, which reflects expenses for the investment project on its balance sheet. The SPV structure is an important advantage for both municipalities and private investors, because it eliminates the burden from the balance sheet and isolates project risks within the SVP.

Financing by utilities. Energy Efficiency Obligation Schemes (EEOSs) are operational in eleven EU Member States[1]. EEOS is a policy mechanism that requires energy providers and/or distributors included in the scheme to meet certain energy saving targets through investments in eligible end-use energy-efficiency measures. Depending on relevant national legislative provisions, street lighting may also be an eligible measure. In on-bill financing, the utility provides a loan to a municipality for the upfront investment and the municipality repays the cost through its energy bills. On-bill financing is more common in the United States than in Europe.

Crowdfunding. Crowdfunding is a relatively new financing option and is most often used by young, innovative companies and startups for small or medium-scale projects. It involves raising funds from a large number of individuals or small-scale investors through online platforms. Crowdfunding creates a community around the project, allowing people to become more engaged and to provide useful insights and ideas to improve the project. Use of this instrument for community and city projects is also increasing (European Commission 2016b).

[1] Denmark, UK, Ireland, France, Spain, Italy, Latvia, Poland, Bulgaria, Austria, and Slovenia.

Figure 2: Summary of findings

Model	Good for municipalities, as they	Not perfect for municipalities, as they	Projects financed
Self-financing			
Municipal budget	1. own and design the project; 2. pay no interest on capital; 3. receive fully saved energy costs;	1. must finance all upfront costs; 2. bear all investment risks; 3. may lack the capacity; 4. May lack the transparency;	1. any type given the budget availability and expertise;
Internal revolving funds (Intracting)	1. can reuse capital; 2. do not need external capital; 3. cooperate within their units; 4. pay no interest on capital;	1. must finance all upfront costs; 2. bear all project risks; 3. may be less efficient than a private actor in project implementation;	1. any project, including small-scale and not attractive to private investors;
External revolving funds	1. can reuse capital; 2. can design a self-sustaining fund with a long-term orientation; 3. may attract private investment;	1. face high transaction costs for the fund setup; 2. must allocate manpower for the duration of the whole project; 3. may experience tensions if private and public capital is merged;	1. long-term projects with multiple objectives in medium to large size municipalities; if municipalities are small, they can merge their funds;
Debt financing			
Concessional loans from public banks	1. pay low-interest rates 2. can access capital 3. can combine this model with others (e.g., a revolving fund)	1. still pay interest on capital	1. particularly accessible for public energy efficiency projects;
Commercial loans from banks	1. can access capital 2. can combine this model with others (e.g., a revolving fund)	1. obtain conventional debt based on their credit record 2. pay interest at market rates 3. do not have access to special conditions for energy-saving projects	1. financially sustainable infrastructure projects of various sizes;
Municipal bonds	1. can access capital at a lower cost than that available from commercial bank loans;	1. carry costs of extensive preparation 2. needs either a good credit rating or access to a bond agency;	1. medium- to large-scale financially sustainable projects;
Institutional investors	1. enjoy a low cost of capital because institutional investors are long-term orientated and risk-averse;	1. may need to deal with a lack of experience of institutional investors in sustainable projects; 2. carry high transaction costs;	1. large projects are competitive in terms of financial risks and return;
Financing by a private contractor			
Simple contracting model	1.can use off-balance sheet financing; 2.can select specialised companies through a tendering process;	1. may incur higher financing costs than those charged for concessional loans; 2. may have limited access to public support;	1. medium- to large-scale projects;
Model with forfaiting and waiver of defence	1. and 2. are the same as in the previous model; 3. pay lower interest rates than those incurred under the simple contracting model;	1. face higher interest rates than in concessional loans; 2. must contend with highly complex financing arrangements; 3. must provide a guarantee for a bank;	1. medium- to large-scale projects;
Private-partner financing through energy saving			
EPC – guaranteed savings	1. obtain new infrastructure without peaks in their spending; 2. outsource risks to contractors; 3. pay constant bills during the contract, possibly lower than before; 4. enjoy low operating costs once the contract expires;	1. may face a problem to attract private partners if a project is too small; 2. may face low financial performance in case energy prices are low; 3. face a lack of motivation by private partner to reduce energy demand more than guaranteed in the contract;	1. projects with the potential to accrue high energy cost savings; 2. municipalities should have sufficient financial resources to pay the fees specified in the contract;
EPC – shared savings	1., 2., 3., and 4. are the same as in the previous model; 5. receive a share of any excess energy cost savings 6. accrue additional energy savings due to incentives to both sides	1. and 2. are the same as in the previous model;	1. and 2. are the same as in the previous model;

Model	Good for municipalities, as they	Not perfect for municipalities, as they	Projects financed
EPC - related payments	1., and 2. are the same as in the previous model; 3. benefit from a mechanism enabling more accurate quantification and verification of energy;	1., and 2. are the same as in the previous model;	1. and 2. are the same as in the previous model;
EPC - immediate savings	1., and 2. are the same as in the previous model; 3. realise maximum energy savings immediately;	1. and 2. are the same as in the previous model; 3. have relatively old infrastructure by the end of the contract;	1. and 2. are the same as in the previous model; 3. projects with very old and inefficient infrastructure;
EPC - staggered savings	1., and 2. are the same as in the previous model; 3. enjoy relatively modern infrastructure for the length of the contract;	1. and 2. are the same as in the previous model; 3. obtain access to all energy savings at a later stage;	1. and 2. are the same as in the previous model; 3. projects in which age and technology vary among existing luminaires;
Public-private partnership			
Sell to a private partner and leasback	1. spread financial risks and costs over time; 2. outsource technical risks to the private sector; 3. enjoy new infrastructure without increasing their debt;	1. may pay higher costs to lease than to self-finance in the long term; 2. may have less control over assets;	1. projects with high upfront costs;
Concession to a private partner	1., 2., and 3. are the same as in the previous model; 4. can set standards in the concession agreement;	1. must contend with complex setup and administration; 2. must provide adequate project oversight;	1. projects with high upfront costs;
Project finance	1. isolate project risks within a special purpose vehicle; 2. may deduct or withhold a certain amount from payments or impose penalties if private partners fail to deliver agreed services;	1. encounter high transaction costs for the preparation and implementation of the special purpose vehicle;	1. large projects (>€20m); 2. a consortium of several municipalities and investors/financiers;
Financing by utilities			
Energy efficiency obligation schemes (EEOS)	1. benefit from the pressure created by a EEOS on utilities to meet targets through financial penalties; 2. do not bear high upfront investment costs;	1. need a strong regulatory framework; 2. need strong governance;	1. possible in countries that have implemented EEOS;
On-bill financing	1. repay investments through energy bills; 2. enjoy a relatively simple implementation process;	1. may encounter challenges arising from a lack of experience because the model is rarely implemented in Europe;	1. small to medium-sized projects;
Financing by citizens			
Crowdfunding	1. can attract substantial private investment from a large pool of backers;	1. lack a guarantee that sufficient funding will be raised; 2. may encounter problems resulting from investor experience; 3. may encounter investors who wish to exit; 4. must contend with a lack of regulation; 5. may find it challenging to fulfil responsibilities to a multitude of small investors;	1. small to medium-sized projects.

Source: Authors’ own table.

1. Introduction

Investments in upgrading urban street lighting infrastructure save energy, reduce carbon dioxide (CO_2) emissions by up to 80%, are highly cost-efficient and have a short payback period. In spite of these advantages, a large share of the infrastructure in many European countries requires refurbishment. Budgetary constraints on infrastructure owners (often municipalities or municipality-owned companies) are frequently cited as a reason for inaction.

Many municipalities and municipality-owned utilities retrofit the street lighting infrastructure from own resources. However, because they often lack sufficient capacity and/or funds for the upgrade, they frequently seek support from public sources (usually in the form of grants and/or rebates) or from third-party financing. In the latter scenario, retrofits may require contractual agreements between several parties. Attracting these parties will require creative financing models.

This report presents the evidence base for the design of the guide to finding a suitable financing model for public lighting investment. It identifies, reviews, and analyses the models implemented to finance upgrades of urban street lighting infrastructure. These include alternative methods for self-financing, debt-financing, self-financing, debt-financing, financing by a private contractor, financing by a private contractor through energy savings, financing by public-private partnerships, financing by utilities, and financing by citizens, with a primary focus on the models that minimise the burden on public budgets. The report summarises each model, identifies the projects to which it could be applied, specifies its advantages and disadvantages, and provides a case study.

This paper expands on one of the deliverables of the Dynamic Light project, which aims to promote dynamic, intelligent, and energy-efficient urban lighting in Central European countries, including Austria, Croatia, the Czech Republic, Germany, Hungary, Italy, Poland, Slovakia, and Slovenia. The project is co-financed by the Interreg Central Europe platform.

The primary intended audience for the report consists of the organisations that own, operate, and take decisions on the modernisation of the street lighting infrastructure in Central Europe, e.g., municipal governments, municipally owned utilities, and the private or partially private companies delivering these functions. The report is also intended for the organisations that play a role in financing the street lighting upgrades, such as the operators of the European Union (EU) funds, the operators of the federal support schemes, public and commercial banks, energy service companies, manufacturers of advanced lighting solutions, and institutional investors (pension funds, insurance funds, investment funds, and other agents in the capital market) interested in diversifying their portfolios.

2. Self-financing

The most straightforward financing option for a municipality to upgrade street lighting infrastructure is to pay for it from own funds. In some of the countries of Central Europe (e.g., Germany and Austria), it is very common to use municipal budgets and dedicated national or federal funding sources to fund municipal infrastructure projects.

There are several viable options for organising such financing. First, if cash reserves provide a sufficient budget in a given year, the upgrade could be done immediately. Second, a municipal unit might choose to implement incremental street lighting updates, enabling it to use the resulting energy savings to repay investments in instalments (i.e., by creating a revolving structure). Third, organisational units within individual municipalities could contract each other to implement progressive street lighting updates from accrued energy savings. We discuss each of these alternatives in detail below.

2.1. Financing from municipal budgets

Model overview:

This financing model for infrastructure upgrade projects is rather simple: a municipality identifies a need for investment, prepares a funding request, obtains approval, issues a tender, and selects a contractor (e.g., an ESCO) to carry out the upgrade.

Advantages:

The first advantage is that a municipality acquires full ownership of the project. Second, by using own resources, it avoids interest payments. Third, a municipality receives all savings on energy costs. Finally, the municipality decides how and when to complete the upgrades.

Disadvantages:

Municipalities are often forced to use their own (generally limited) budget resources to cover all upfront costs for long-term infrastructure investment. They also bear all risks, including those related to technical problems, poor decision-making, and failure to deliver energy savings. In addition, citizens might claim that project-related decisions taken by municipalities are not fully transparent. Finally, unlike private service providers, municipalities may lack the best available technology, expertise, and capacity required for project implementation.

Projects that can be financed with this model:

The model can be used for any type of infrastructure project in any jurisdiction. Although it presents obvious advantages and has been employed successfully for numerous projects, municipalities often pursue other alternatives, due in large part to municipal budget constraints and limitations on human resources and expertise. Municipalities seek options that reduce technical and financial risks and enable them to avoid paying the full amount of upfront costs.

Jurisdictions that have applied the model:

Central European countries use this model most frequently to finance street lighting upgrades. Below, we provide a case study of how the model was used by the city of Heidelberg.

Case study: Heidelberg, Germany

Background:

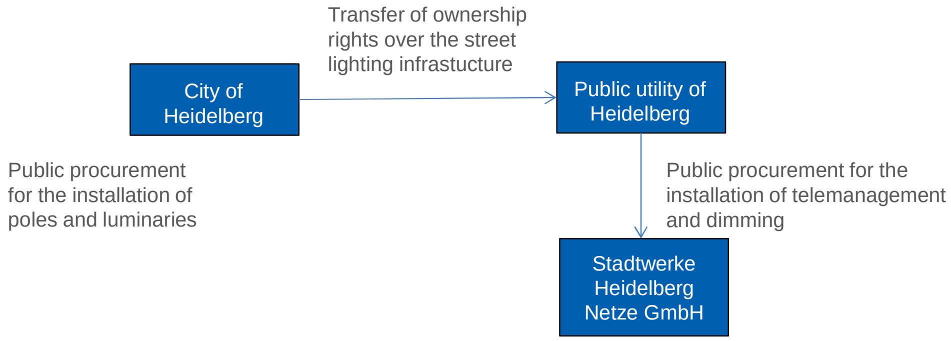
Heidelberg is a small to medium-sized city in Southwest Germany. Between 2012 and 2017, the city's population grew from 138,000 to 150,000 people. In order to accommodate the population growth, in 2008 the city of Heidelberg began to convert land once occupied by a railroad terminal into a modern green district. The area, known as Bahnstadt Heidelberg, has a maximum capacity of 12,000 persons. Energy-efficient and smart street lighting concepts were one of the central elements incorporated into the development (Heidelberg Bahnstadt 2014). Although these concepts were not required to fulfil specific energy-efficiency requirements, they were subject to the guidelines of DIN 13201 on road lighting (Herb email com.).

Project timeframe: 2008-2025.

Key stakeholders:

The model did not incorporate any external stakeholders, such as external capital providers or ESCOs. The City of Heidelberg and the municipal utility company, Stadtwerke Heidelberg Umwelt GmbH, supplied the entire upfront investment. Stadtwerke Heidelberg Umwelt GmbH owns and invests in the procurement and installation of poles and luminaires integrated into the telemanagement system, and the contractor for the installation is Stadtwerke Heidelberg Netze GmbH.

Figure 3: Operation and financing of smart lighting in Bahnstadt Heidelberg



Source: Authors' own figure.

Financing structure:

The City of Heidelberg financed the initial costs of street lighting infrastructure, including the cost of the design, purchase, and installation of poles and luminaires. After their installation, the City transferred the ownership, maintenance, and operation rights to its public utility. The utility financed additional energy-efficiency measures, such as telemanagement and dimming systems. The utility reaps all financial benefits of the project, including the costs saved through maintenance and operation of the upgraded infrastructure technology (Herb email com.).

Project scope:

The expansion of Heidelberg Bahnstadt has paralleled general development of the district. It is likely that, by 2025, more than 1,000 luminaires will be installed over a distance greater than ten kilometres.[2]

[2] https://www.swhd.de/de/Imageprojekte/Bahnstadt/Licht/Licht.html

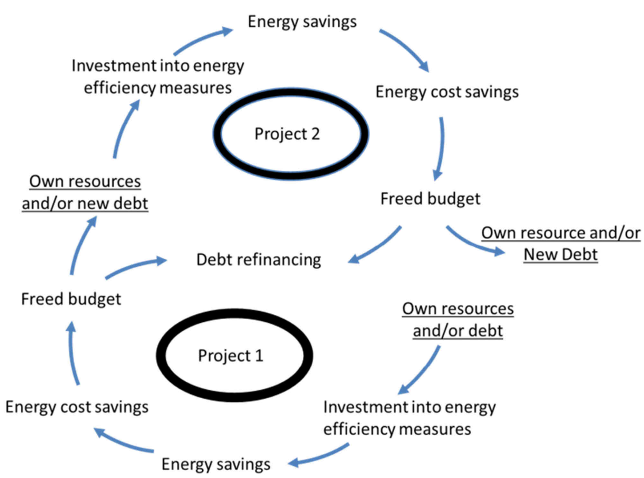
Project implementation and outcomes:

The street lighting concept relies on light-emitting diode (LED) luminaires, the telemanagement of street lighting levels, and dimming technology. At night, light output reaches 100% on bike paths when pedestrians or bikes pass by and dims to 30% when streets are not in use. In all streets, the lighting dims incrementally based on traffic. Overall, the concept saves up to 75% of the electricity costs of conventional alternatives. In 2013, the concept received the Auroralia Award at the annual international Auroralia competition, and the public utility of Heidelberg was the 2016 recipient of the German Green Public Procurement Award.[3] The public utility of Heidelberg invested a total of €3.5m in the project, which is projected to save nearly €120,000 in electricity costs over its estimated 30-year life span as compared to conventional alternatives.

2.2. Financing using revolving funds

To minimise the burden on tax payers, the public sector can establish a revolving fund to multiply available capital. Figure 4 illustrates a revolving fund organised for energy efficiency projects. A municipality invests capital (e.g., equity or debt) into a project (e.g., a street lighting upgrade). The project saves energy, which translates into energy cost savings that free up some of the budget resources previously used to cover utility bills. These funds, in turn, can be used to repay the initial investment and/or reinvest in new projects, thus creating a revolving model.

Figure 4: Capital flow in a revolving fund



Source: Authors' own figure.

Revolving funds can be created in multiple ways and at different levels. For example, although these funds are typically organised at the national level, they can also be established under municipal, regional, or national governments. The design and implementation of municipal revolving funds has been successful in several cases.

Another option is whether to set up an internal fund, fully financed through money from the internal municipal budget, or an external fund, financed through public resources and external funds from donors, financial institutions, and private investors. For project implementation, municipalities can rely on their

[3] https://www.swhd.de/de/Imageprojekte/Bahnstadt/Licht/Licht.html

public bodies and departments or outsource necessary measures to service providers (e.g., ESCOs). Most municipalities choose to do one of the following:

a) Set up an internal revolving fund and perform all project work without external service providers (i.e., 'intracting'; see below);

b) Set up an internal revolving fund and outsource project implementation to service providers and ESCOs;

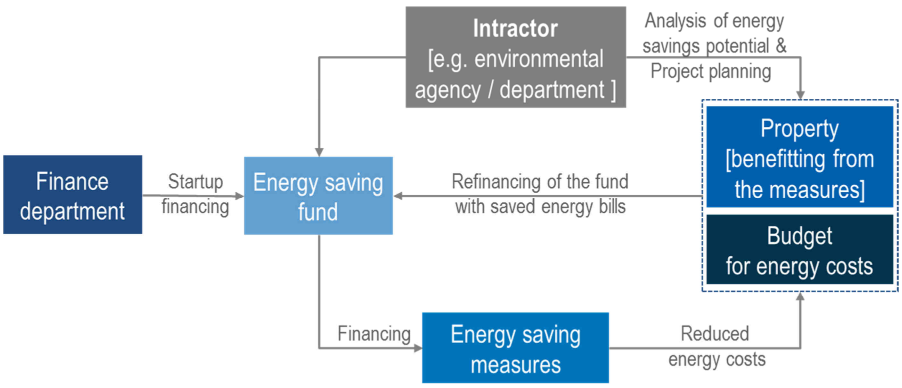
c) Set up an external revolving fund with multiple financiers, service providers, and ESCOs.

2.2.1. Internal performance contracting ('intracting')

Model overview:

Internal performance contracting is a financing scheme in which organisational units within a municipality are contracted to implement a project without the need for external financiers. Energy efficiency measures are financed through reduced energy costs. The main actors in the intracting model are presented in Figure 5.

Figure 5: Sample intracting model



Source: Junghan and Dorsch (2015).

The municipal budget supplies most of the initial financing, for example by setting up a dedicated revolving fund or trust. Intracting is therefore a variation on the internal revolving fund model. The fund or trust will finance energy efficiency or other emission reduction measures without any extra charges and at a 0% interest rate. Creating a fund or trust of this kind requires political support and commitment from the department(s) responsible for the budget and must be compatible with the existing legal framework (EnergyCities 2016; Irrek et al. 2005).

The 'intractor' is another administrative unit (e.g., environmental agency, street lighting department, or municipally owned company) that takes on the responsibility conventionally allocated to an ESCO. The intractor assesses energy savings potentials, calculates the investment costs and payback period, and plans the project. It is crucial for the intractor department to have the skills and expertise required to prepare and implement such projects successfully. Once the project is implemented, cost savings gradually replenish the fund or trust until the investment has been paid off. The repaid resources are then used to finance new energy efficiency projects (Junghans and Dorsch 2015; EnergyCities 2016).

This model can be used to finance the following projects:

This financing scheme can be used for municipal infrastructure projects, such as improvements in energy efficiency, street lighting, and combined heat and power plants. The maximum project size depends on the total funding available from the finance department (Junghans and Dorsch 2015). Thus far, most projects financed under this model have been energy-saving measures in public buildings.

Advantages:

Intracting enables municipalities to use energy savings to finance energy efficiency measures without the involvement of external financiers. Cooperation between the units within a municipality thus helps to bridge the traditional divide between municipal investment and operational budgets. Projects that are too small or fail to attract private investment can be financed under this model with a 0% interest rate on investment capital. There are also minimal transaction and administrative costs, and the legal paperwork required is much simpler than that for external contracting (EnergyCities 2016).

Disadvantages:

This model has the limitations generally associated with self-financing. For example, the municipality must provide the upfront capital. Municipalities use various approaches to sustain the fund and increase the finances available. They include the projects on the municipal balance sheet and bear all investment risks. Finally, projects financed by the municipalities may be implemented less efficiently than those funded by private investors (Junghans and Dorsch 2015; Seifried 2011).

Jurisdictions that have applied the model:

Intracting was conceptualised and adapted in Germany. Stuttgart, Lörrach, Kiel, Frankfurt, Bonn, the Federal State of Baden-Württemberg, and several municipal districts in Ireland have implemented internal performance contracting schemes (Schilken and Wyssling 2013). Recently, additional European cities—including Agueda and Almada, Portugal; Udine, Italy; and Koprivnica, Croatia—have introduced intracting into their jurisdictions (Junghans and Dorsch 2015; Schaefer et al. 2017). Early assessments of the model were based on trial runs for lighting upgrades in public buildings in Salzburg, Austria; the University of Bordeaux, France; Niguarda Hospital, Italy; the Province of Bologna, Italy; Jordanów, Poland; and Malmö, Sweden (Irrek et al. 2005).

Case study: Udine, Italy

Background:

Udine is a small to medium-sized Italian city of 100,000 inhabitants. In 2015, its total energy cost was €4.3m. The city actively promotes sustainable development, including through the deployment of renewable and energy-efficient technologies. The Sustainable Energy Action Plan (SEAP) outlines energy targets, including a goal to reduce CO_2 emissions in Udine by 21% by 2020 (Infinite Solutions 2017; Schaefer et al. 2017).

In 2015, the city set up a revolving 'climate fund', which later became the financial instrument of the SEAP and was renamed the 'SEAP fund'. The SEAP fund does not solely finance street lighting; it provides funds for measures that are identified in the SEAP and fulfil certain criteria. The fund, which initially contained €32,000, will be refinanced through various sources, including the costs of energy and maintenance saved as a result of the city's energy-efficiency measures (Schaefer et al. 2017).

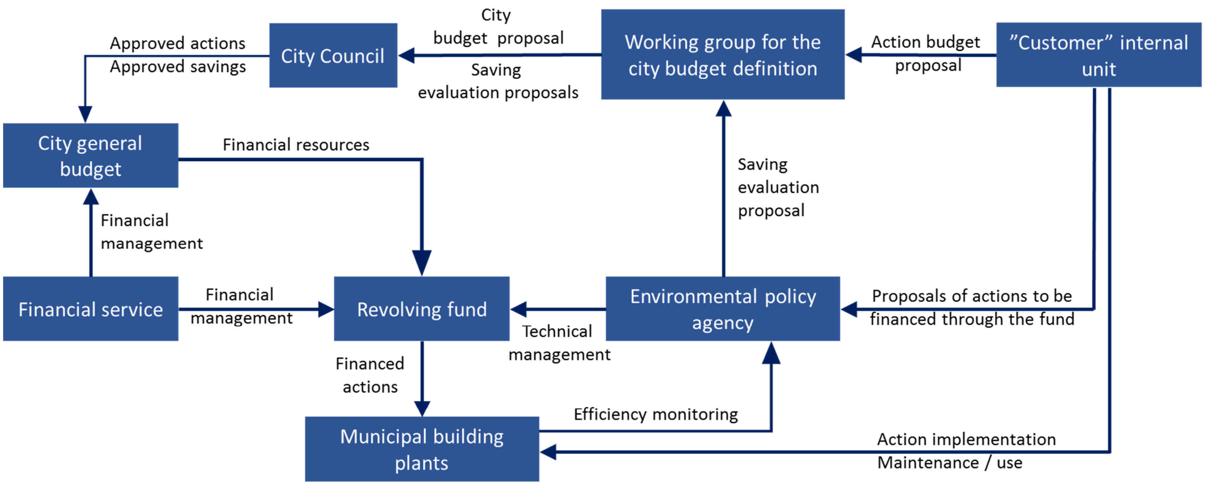
Project timeframe: 2015–ongoing.

Key stakeholders:

This model does not include external stakeholders, such as ESCOs or third-party financiers. The only entities involved are city units and departments. Staff assigned to the fund consists of two technical experts, one financial expert, and the head of the technical department. Figure 6 presents the key elements of the Udine SEAP fund.

The Municipal Agency for Environmental Policies provides technical expertise and management and plays the role traditionally taken by an ESCO. Other internal units and departments can submit their proposed energy efficiency measures for financing from the SEAP fund. The Municipal Agency for Environmental Policies approves measures and calculates achieved energy and cost savings. The latter are directed to refinance the fund (Schaefer et al. 2017).

Figure 6: Operation and financing of Udine SEAP fund



Source: Schaefer et al. 2017.

Financing structure:

The SEAP fund initially contained €32,000, which had been allocated from the city budget. To increase the amount of funding available, the city redirected cost savings generated by four pilot energy efficiency projects implemented in 2015. The projects were not financed by the SEAP fund but will feed energy cost savings into the fund to finance future energy efficiency measures (Infinite Solutions 2017).

Finding financial resources to set up the fund was the biggest challenge. The city plans to increase the amount of funding through savings from the lower energy and maintenance costs for projects; income from investment in energy efficiency credits on the energy market; and city budget allocations for SEAP implementation (Schaefer et al. 2017).

Project scope:

Project proposals submitted to the fund by city units and departments are assessed on the basis of defined investment criteria and funding availability. All projects must comply with the SEAP. Retrofit measures must achieve CO_2 emission reductions and energy savings of at least 10%. There are also requirements related to the expected life span of the intervention and the return on investment. Proposed measures are then evaluated and ranked in accordance with these criteria (Schaefer et al. 2017).

The first three projects financed by the fund were lighting upgrades in a number of public buildings, including the city hall, a primary school and a car park. The total cost of project investment is €29,533. Cost savings from these projects will be returned into the fund to finance new energy efficiency measures in the public sector (Infinite Solutions 2017).

Project implementation and outcomes:

The fund is a relatively new development and has financed few projects thus far. Nevertheless, the city is strongly committed to increasing the amount of SEAP funding. Setting up the fund has led local staff to acquire new skills and expertise. Monitoring and evaluating the fund activity will also provide additional and detailed data on energy consumption in public buildings and other assets.

2.2.2. Establishing an internal revolving fund and outsourcing service provision

Model overview:

Under this model, a municipality or municipal bodies provide the initial capital and manage the fund. The revolving nature of the fund is described in the introduction to this section. The revolving fund provides finance (grants, loans, or other financial instruments) to external service providers and ESCOs to implement energy efficiency projects. The replenished capital and energy savings are reinvested into new energy-saving projects. If municipalities are small and do not have enough resources to set up an individual own fund, they could combine their resources to create a common revolving fund with shared management and operating costs.

Projects that can be financed with this model:

The model could be applied within medium-sized to large cities or groups of smaller municipalities that need to finance long-term and multi-objective projects, including those for building energy efficiency improvements, street lighting, combined heat and power plants, and renewable energy. The maximum project size will depend on the size of the total budget available from the fund. However, cumulative energy savings should be significant enough to justify the complex set-up required for the fund and its operating costs.

Advantages:

The key advantage of the model is its sustainability and long-term orientation. Once a revolving fund has been established and energy savings accrued from the first tranched investments, the resulting energy savings can be used for new projects. Ideally, interest rates, fees, service charges, and/or energy cost savings could completely cover fund operating costs (ESMAP 2014; Limaye et al. 2014). An internal revolving fund provides an alternative financing mechanism for municipalities that have limited borrowing capacity (European Commission 2017b).

Disadvantages:

Establishing a revolving fund requires significant political commitment, as well a sizeable investment of time and institutional and human capacity. Cash inflows will accrue only after several years, so recovering fund operating costs may be a lengthy process (Limaye et al. 2014). Therefore, financial sustainability is important to ensure the continued cost-effectiveness of the fund, as well as the long-term strategy for resource mobilisation. Furthermore, a revolving fund requires an entity to manage the funds to ensure good governance and administration. Finding a dedicated and experienced staff to support and operate the fund is sometimes difficult, especially in small municipalities (ESMAP 2014).

Jurisdictions that have applied the model:

The energy saving fund implemented in the Czech town of Litoměřice is one example of an internal municipal revolving fund with the outsourced service provision.

Case study: Litoměřice, Czech Republic

Background:

Litoměřice is a town in North Bohemia, Czech Republic, that had approximately 24,000 inhabitants as of 2017. The town's main energy source is coal, which has caused high levels of air pollution. As a result, in 2000, the town developed a strategy to promote energy efficiency and renewable energy use. Under the new strategy, the town of Litoměřice set up a revolving municipal energy saving fund (ESF) in 2014 in order to use limited financial resources in an effective manner (City of Litoměřice 2017).

Project timeframe: 2014–present.

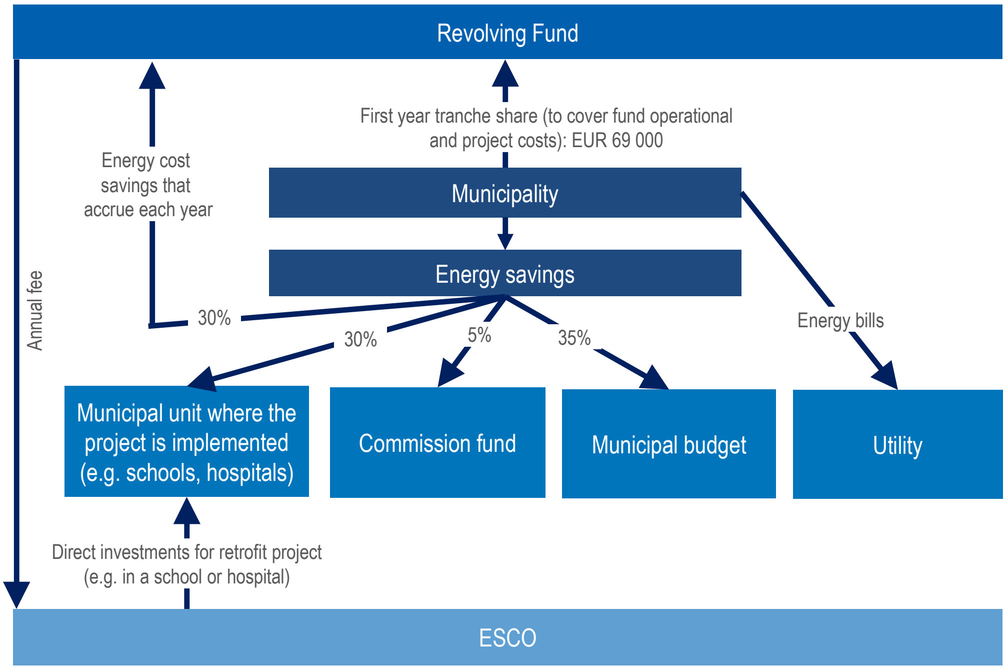
Key stakeholders:

The town of Litoměřice provided the initial capital and manages the fund itself. The European Union's Horizon 2020 research and innovation programme provided funds to conduct background research and develop the concept.

The municipal participants in the ESF include a fund manager, municipal council, and town financial committee (City of Litoměřice 2017). The fund manager, who is also responsible for the town's energy management, is the party that introduced the fund concept and developed the methodology. The municipal council considers and approves the concept. Finally, the financial committee assists the fund manager in allocating the capital generated from saved energy costs.

For energy efficiency projects for municipal entities (such as schools and hospitals), ESCOs contracted through the ESF are based on the EPC model with guaranteed savings (see section 5.1 for further information). Figure 7 presents the stakeholders and financial flows observed in the case study.

Figure 7: Litoměřice internal revolving energy efficiency fund



Source: Authors' own figure. Data from City of Litoměřice (2017) and Klusák email com.

Financing structure:

In its first year (2014), the municipal budget allocated €69,000 to the ESF to cover its operating costs and the initial tranched investment. Under the model, ESCOs are contracted through the ESF to implement energy efficiency measures for an annual fee, which is paid within the contract period through the ESF and the municipal units in which the energy efficiency projects were executed. ESCOs may invest in these measures using own resources or obtain them from third-party financiers, such as public or commercial banks. ESCO involvement ensures that some portion of energy costs will be saved.

Each year, the city monitors real energy savings, from which it deducts the annualised costs of the measures to determine the net energy cost savings. These savings are distributed as follow: 35% to the municipal budget, 30% to the ESF revolving fund, 30% to municipal units where energy efficiency projects are located, and 5% to the Commission Fund. The latter is an incentive mechanism that offers extra payments to the public employees involved in energy saving projects in a given year (City of Litoměřice 2017; Klusák pers.com.).

Project scope:

The fund only covers energy efficiency improvements in public institutions. Payments cover various activities, such as energy audits, procurement, and the preparation, analysis, and implementation of selected measures. These measures may include building retrofits, street lighting, photovoltaic installations, and purchases of electricity and gas on the stock market.

Project implementation and outcomes:

Between its inception and 2017, the fund yielded energy savings of approximately €300,000 (City of Litoměřice 2017). The city anticipates that, as a result of the fund, it will consume 20% less energy by 2030 than it did in 2013 (City of Litoměřice 2017).

2.2.3. Establishing an external revolving fund with multiple financiers and service providers

Model overview:

A revolving fund can also use external funding sources and provide finances to municipalities for energy efficiency projects. The money to operate the fund and supply the first and future tranched investments could originate from one source or a combination of sources (European Commission 2017a). Potential sources include grants and/or loans from public and private sources, such as the national or regional government, financial institutions, utilities, energy service companies, and/or other capital providers. If a fund of this kind becomes self-sustaining over time, it can lend repaid capital to new projects and finance its operating costs from service charges and interest on loans (Limaye et al. 2014). The external fund is often managed by a dedicated fund manager, which could be a specially created new entity, a utility, an ESCO, or another organisation (ESMAP 2014).

Figure 8 illustrates an example of an external revolving fund that provides loans to municipalities. The municipalities contracts a third party to carry out an infrastructure project, such as a street lighting upgrade, and repays loans from saved energy costs. The contracts may be conditional on the contractors' compliance with performance standards.

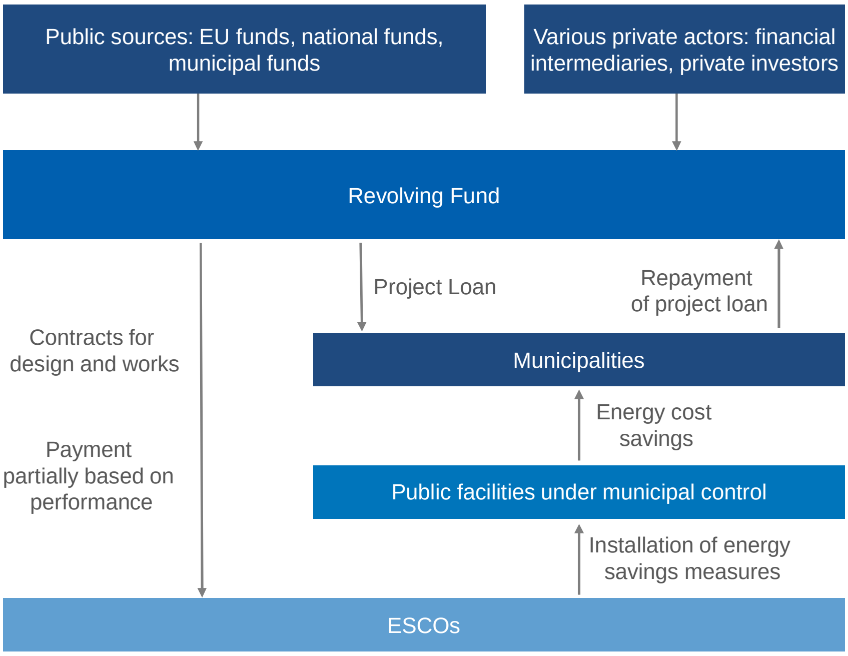
Projects that can be financed with this model:

As is the case for internal energy efficiency funds, the success of this financing model depends on the available funding and programmatic priorities of the specific project.

Advantages:

One obvious advantage of external revolving funds is that, by combining sources (financial institutions and private investors in particular), they make it possible to obtain greater funding. Private investors can participate in urban development projects that showcase energy efficiency benefits to citizens and communities (ESMAP 2014).

Figure 8: Model of sample external revolving energy efficiency fund



Source: adopted from ESMAP 2014.

Disadvantages:

The process of setting up a revolving fund, particularly an external one, requires the cooperation of various stakeholders and involves several steps, which increases the complexity of the financing model. The role of a private entity as a fund manager of a partially public fund might pose a political challenge, especially when such fund has the potential to act monopolistically (ESMAP 2014). If a revolving fund uses private and public capital, tensions may arise as a result of the transfer of most responsibilities from donors to fund managers (e.g. project selection) (Oxfam 2017).

Jurisdictions that have applied the model:

Examples of external revolving funds at the national level are the Croatian Energy Efficiency Fund and the Bulgarian Energy Efficiency Fund, both of which finance street lighting projects. Energy Fund Hague (see below) is an example of external municipal revolving funds, although it has not financed street lighting projects.

The Croatian Energy Efficiency Fund provides grants and loans to municipalities at low interest rates for street lighting projects, including those with ESCO participation. As of 2017, the fund co-financed more than 300 public street lighting projects. The fund provided more than €15m of the total value of these projects, which exceeded €35m (EPEEF n.d.). The funding for energy efficiency projects is generated from sources including regional and municipal budgets; international bilateral and multilateral cooperation programmes; projects and similar activities in the field of environmental protection and energy efficiency; revenue and inflows from the management of free financial assets associated with the fund; and donations and assistance. The operational costs of the fund are financed from the revenue obtained from financial penalties for environmental polluters, environmental user fees, fees for environmental waste, and special environmental charges for motor vehicles.

The Bulgarian Energy Efficiency Fund provides technical assistance to municipalities for the development of street lighting projects; assists in financing and co-financing; and provides guarantees to other financing institutions. As of September 2017, it had financed or co-financed approximately 200 various energy efficiency and renewable energy projects (approximately €40m in total) and had provided credit guarantees to more than 30 projects (approximately €12m in total) (Energy Efficiency and Renewable Sources Fund 2017). Initial funding comes from the Global Environment Facility (GEF), the governments of Austria and Bulgaria, and private Bulgarian donors.

Case study: The Hague, Netherlands

Background:

The Hague is a city in the Netherlands with a population of roughly 500,000. In 2013, The Hague introduced a revolving fund, the Energy Fund Hague (ED), to support projects improving urban development and renewable energy infrastructure by mitigating the high initial costs of these projects (CityInvest 2015). The fund is organised as a limited partnership under Dutch law (C.V. or Commanditaire Vennootschap) and incorporated by the municipality.

Project timeframe: 2013 – ongoing.

Key stakeholders:

Figure 9 presents the key stakeholders in the Energiefonds Den Haag [Energy Fund The Hague (ED)]. As the figure illustrates, ED is one of two subordinate funds of the Holdingfonds Economische Investeringen Den Haag [Holding Fund for Economic Investment The Hague (HEID)] (SVn n.d.). HEID, established two years before ED, promotes integrated and sustainable urban development. It develops the investment strategy for its subordinate funds and functions as a financing intermediary for the transfer of funds. It also acts as the controller and coordinator of Programme Authority The Hague.

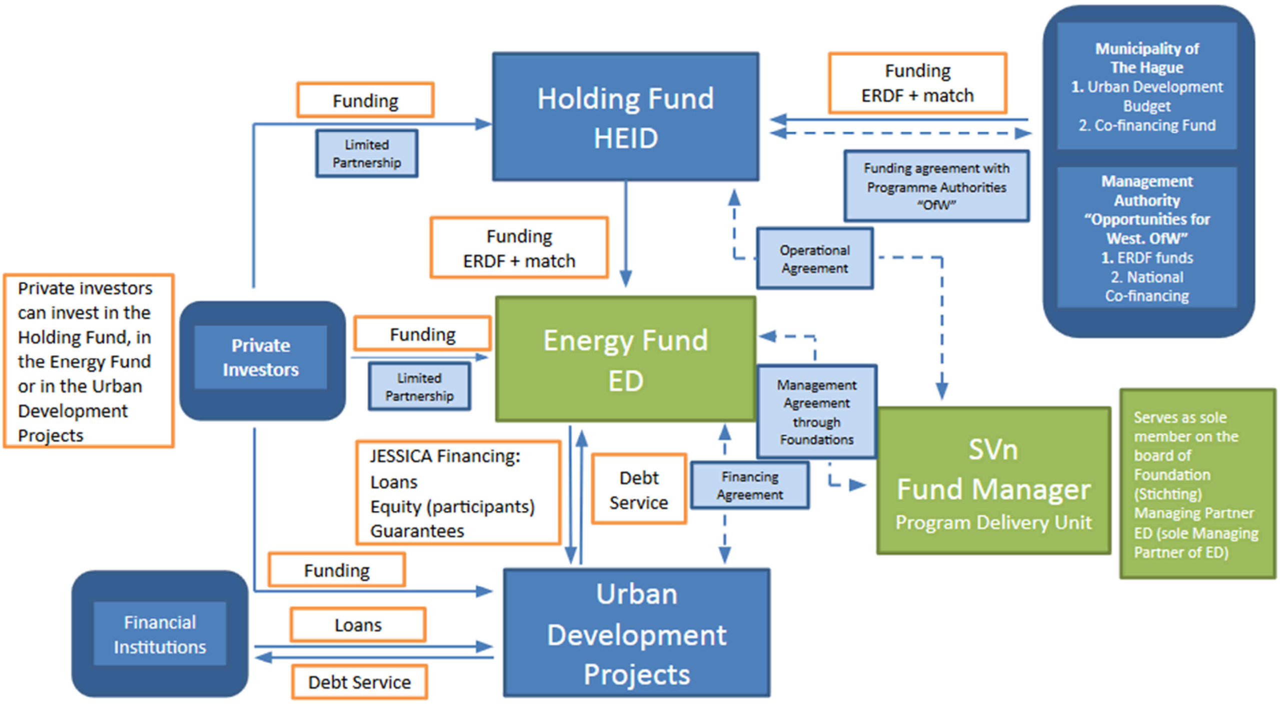
HEID has created two subordinate funds based on the financial mechanisms of the Joint European Support for Sustainable Investment in City Areas (JESSICA). JESSICA assists EU countries in using available European structural and investment funds (ESIF) to finance revolving funds. Its objective is to develop sustainable facilities that will accelerate investment in urban areas (European Commission 2014a).

ED, one of two HEID subordinate funds, was created to provide financial support for urban development projects that increase renewable energy use and improve energy efficiency. Initial funds, which covered operating costs and the first tranched investments, were provided from the European Development Fund (ERDF) operational programme 'Opportunities for the Western Netherlands', with co-financing from the national public budget and from the city's urban development budget and its co-financing fund. ED also works to blend money from private, profit-oriented investors with public resources.

The fund manager, Stichting Stimuleringsfonds Volkshuisvesting Nedelandse gemeenten (SVn) [Dutch Municipal Incentive Fund for Social Housing], is a non-governmental organisation (NGO) that manages funds on behalf of the government of the Netherlands. As of 2017, SVn had managed the funds of 350 Dutch municipalities.

Potential beneficiaries[4] that apply for ED funding must fulfil multiple criteria. For example, they must meet eligibility requirements for the 'Opportunities for the West' and be consistent with the investment strategy established by HEID. In addition, the projects must be based on a sound business plan and attempt to secure as much external funding as possible.[5]

Figure 9: Key stakeholders in the Energy Fund The Hague



Source: (CityInvest, n.d.)

Financing structure:

HEID obtained €3.7m of the initial funding from the ERDF operational programme 'Opportunities for the Western Netherlands' and €0.3m from the national budget, as well as €2.9m from The Hague's urban development budget and €2.0m from its cofinancing fund (Luigjes email com.).

HEID disbursed the funds to its subordinate funds, including ED, in accordance with its investment strategy. ED's initial funding from HEID of €4.0m consisted of €1.7m from ERDF funds, €0.3m from the national public budget, and €1.0m each from The Hague's municipal urban development budget and cofinancing fund. The fund aims to obtain half of its finances from private investments (CityInvest 2015). Private money accounted for more than €1.0m of the funds acquired between 2013 and 2015). In 2017, ED funding from public sources grew to €10.9m (Luidjes email com.; Kansenvoorwest n.d.), while investments from the private sector amounted to €51.5m (Luidjes email com.).

In compliance with the chosen investment strategy, SVn allocates finances to various projects, conducts due diligence, prices loans, sets conditions for guarantees, and establishes equity arrangements. It also

[4] For example, a football club in The Hague installed solar power on the stadium roof.

[5] For more details on the fund stakeholders, see City Invest (2015).

monitors fund activity and prepares assessment reports. SVn receives a service fee of up to 2.9% from the capital contributed to the fund. All interest fees and repayments are fully reinvested in new projects (City Invest 2015).

Project scope:

Funds are intended to private and public urban development projects in The Hague, including the improvement or expansion of urban heating and/or cooling networks powered by renewable energy sources (including geothermal energy, biomass, and seawater), as well as energy efficiency improvements in office buildings and private housing. Funding is provided to businesses and NGOs that, though unable to obtain a loan under market conditions, present business models for financially viable projects. Furthermore, potential projects need to provide social value to the municipality (SVn n.d.). Project finances can vary greatly, but the share available for large-scale projects is decreasing (CityInvest 2015).

Project implementation and outcomes:

As of 2017, ED had funded a range of private- and public-sector urban infrastructure projects, contributed to a 93-tonne reduction in CO_2 emissions, and created 18 new fund-related jobs (Luidjes email com.). Most of these projects financed through the programme have established renewable energy installations and energy efficiency measures in the commercial sector (SVn n.d.). For example, a sports centre in the Hague, De Uithof, has installed LED lights and electric heat pumps and intends to install solar panels in order to become climate neutral (SVn n.d.). Due to its success, the fund is expected to receive an additional €10m in public funding, some of which will be contributed by the ERDF. ED funds would then total €21m (Luidjes email com.).

3. Debt financing

Many municipalities with limited own funds issue debt that it later pays back from the municipal budget, for example from municipal tax revenue and/or saved energy costs. Under the debt financing model, the municipality incurs debt (e.g., by taking out loans or issuing bonds) and then issues a tender for a contractor to perform the upgrade.

3.1. Debt-based financing: concessional or commercial loans from banks

Model overview:

Most municipalities obtain low-interest ('soft') or concessional loans. Central European municipalities often finance energy efficiency investments with low-interest-rate lending programmes through national development banks, dedicated funds, or European banks and funds (e.g., the European Investment Bank (EIB), European Bank for Reconstruction and Development (EBRD), or the European Energy Efficiency Fund (EEEF)), in cooperation with local commercial banks.

In countries where public lending programmes have limited budgets or do not exist, municipalities obtain market-rate loans from commercial banks. In such cases, the interest rate applicable to the loan does not depend on saved energy costs but on the credit record of the borrower.

Advantages:

Concessional loans allow municipalities to access capital at below-market interest rates and, unlike commercial banks, do not require proof of a flawless credit record. Capital from debt financing can be combined with money obtained from other financing models, including revolving funds, with minimal administrative requirements.

Disadvantages:

Although interest rates are typically low, the municipality must repay the debt. In addition, because the debt is listed on the municipal balance sheet, it weakens the equity-to-assets ratio, with negative effects on the municipality's access to credit.

Projects that can be financed with this model:

If a municipality has a positive credit record, any of its projects can be financed under this model.

Jurisdictions that applied the model:

In Germany, a dedicated programme of the Kreditanstalt für Wiederaufbau [Reconstruction Credit Institute (KfW)], a municipal development bank supported by the German government, offers loans for developing sustainable urban infrastructure and public buildings at interest rates close to 0%. It is the main source of funding available to German municipalities. In Croatia and Lithuania, revolving funds are financed through the federal budget, which provides loans and guarantees to municipal governments for energy-efficiency investments. As loans and guarantees are repaid, the funds are reinvested in new projects (see section 2.2.3).

Multiple loan programmes and other financial instruments are available through European institutions and intermediaries, such as the EIB or EBRD. EU member states are also encouraged to use grants from the European Structural and Investment Funds (ESIF) to create other financial tools (e.g., loans, guarantees, equity, or risk-bearing instruments) to improve the efficiency of EU resources.

Case study: guaranteed loans from the Lithuanian Energy Efficiency Fund

Background:

The Lithuanian Energy Efficiency Fund (ENEF) was established in 2015 by the Ministry of Finance, the Ministry of Energy, and the Public Investment Development Agency (VIPA) of Lithuania. The ENEF channels ESIF finances into the renovation of central government buildings and modernisation of street lighting. For street lighting projects, it provides guarantees for commercial bank loans and decreases municipal costs.

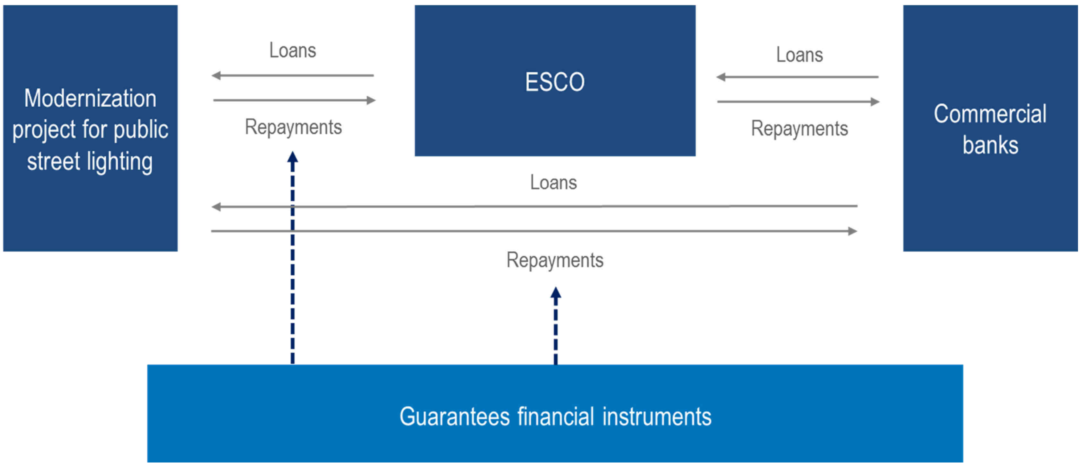
Project timeframe: 2015 - at least 2030.

Key stakeholders:

The ENEF is managed by VIPA, which is wholly owned by the Ministry of Finance. VIPA manages the application process for guarantees, collects fees, and pays compensation. The Ministry is a shareholder and member of the supervisory and management boards of the ENEF (Vaskelienė 2015).

If municipalities and municipal companies are interested in applying for a commercial bank loan or contracting an ESCO, they may apply for an ENEF guarantee. The ENEF assumes these obligations and compensates commercial banks for losses if, in the former case, an applicant cannot repay the bank for the loan and/or loan interest, or, in the latter case, cannot pay the ESCO. Figure 10 illustrates the financial flows in the case study.

Figure 10: Financing incentives from the Lithuanian Energy Efficiency Fund for municipal street lighting



Source: Vaskelienė 2015.

Financing structure:

The fund manages €79.5m, of which up to €14.5m is earmarked for the street lighting financial instrument. For the latter, ENEF offers an 80% guarantee of eligible costs for a timeframe of up to 20 years. The guarantee fee payable by the applicant to ENEF typically depends on the applicant's creditworthiness, but is waived for municipalities and municipal companies (Balčiūtė J. pers. com.).

The public guarantee allows commercial banks and ESCOs to provide more favourable loan and contract conditions to municipalities. In order to apply for the guarantee, the applicants must attach documents including an energy audit or inventory and an investment plan. If municipalities contract an ESCO, the model should comply with the criteria for public-private partnerships defined under the law.

Project scope:

The eligible projects should deliver energy savings of at least 40% and have a maximum payback period of 20 years. Costs can cover modifications including the replacement of lights, upgrades and/or installation of smart or advanced management and control systems, and the reconstruction or installation of distribution and power cabinets between the years 2014 and 2023 (Vaskelienė 2015).

Project implementation and outcomes:

Demand for such funding is very high: by the end of 2015, applications for street lighting funds had reached €95m, well over the €14.5m available through the fund (Vaskelienė 2015). As of April 2017, the fund had approved two street lighting projects, with two more under evaluation and six more in the initiation stage for a 50% investment guarantee from ENEF (Laurusevičienė 2017).

3.2. Debt-based financing: issuing municipal bonds

Model overview:

Municipal bonds are issued by a local government (or their agencies) to raise funds for investment projects. When a municipality issues a bond, it acquires a debt obligation and must pay interest and/or repay the debt in the future. While municipal bonds can be used to finance any type of municipal investment, labelled green bonds are issued exclusively for projects related to sustainability and climate change mitigation. To have a 'green' label, bonds must be certified by an independent institution.

Advantages:

The municipality can raise finances for public projects independently or in coordination with a bond agency. Because bonds generally have low interest rates, it offers capital at a lower cost than do commercial bonds.

Disadvantages:

Issuing municipal bonds may require extensive and costly preparation, such as obtaining a credit rating, acquiring approval from national securities authorities, and consulting with investment brokers. For this reason, many countries have municipal bond agencies, which aggregate debt from multiple municipalities, issue bonds, and sell them in the financial markets. With a high credit rating, agencies can raise capital for municipalities at a lower cost than would be possible if the municipalities issued the bonds themselves. Agencies of this kind are located in Sweden, Finland, France, Denmark, Switzerland, UK, and the Netherlands (ManagEnergy 2017).

Projects that can be financed with this model:

Most municipalities with access to a bond agency can apply this model.

Jurisdictions that have applied the model:

Interest in bonds (especially green bonds) is growing, although bonds are still less common in Europe than in the United States, where they are already in widespread use. The model has been applied successfully in multiple cities in Sweden, where the funding agency Kommuninvest issues bonds to finance projects in local municipalities. Gothenburg, the second largest city in Sweden, was the first city to issue green bonds in 2013 (see the case study below). Paris, Johannesburg, Mexico, Oslo, Vasteras, and multiple jurisdictions in the United States and Canada later followed its example (Climate Bonds Initiative 2017). In the US, the model was implemented in federal and state level programmes with qualified energy conservation bonds (QECBs) as well as in initiatives introduced by individual cities; for example, Detroit and San Diego issued bonds to raise funds for street lighting modernisation (LBNL 2012; Kinzey 2015).

The Bulgarian city of Varna (with approximately 335,000 inhabitants, the country's third-largest city), used municipal bonds to finance energy efficiency upgrades of the city's street lighting in 2002. The process was organised by a financial institution. The bonds were sold out within 24 hours and benefitted the projects financially. The payback period was reduced to less than 3 years, and the interest owed by the municipality under the bond obligation (9%) was lower than the market interest rate charged by banks (12-14%). The project delivered total annual savings of up to 10,035 MWh (€512,000) (ManagEnergy 2017).

Case study: Green Bonds Programme of Gothenburg, Sweden

Background:

The city of Gothenburg introduced its green bonds initiative in 2013. Since then, the city has issued green bonds to raise capital for projects promoting environmental protection and climate change mitigation. It has also implemented the Environmental Programme and Climate Strategy, which set reduction targets for emissions and energy use and define priorities in environmental and climate change initiatives (City of Gothenburg 2015a, 2015b). Green bonds help the city generate financial resources to implement these two programmes.

Project timeframe: 2013–ongoing.

Key stakeholders:

- The City Council develops the Environmental Programme and Climate Strategy and determines the city's investment priorities.
- The City Office (Urban Development and Treasury Departments) selects projects for the green bonds programme in accordance with the Environmental Programme and Climate Strategy;
- The Environment Administration verifies the project selection.
- The City Executive Board provides final approval for the projects supported through the green bonds programme (City of Gothenburg 2017).

Project scope:

Funding is not limited to one specific area (e.g., street lighting), but has a wider scope. The Green Bonds Programme supports three project categories: programmes promoting climate-change mitigation, adaptation and climate-resilient growth, and a sustainable environment (with funds for the latter category accounting for no more than 20% of the total portfolio). Eligible activities include those related to renewable energies and energy efficiency, waste and water management, biofuel, smart grids, sustainable transportation, and housing. The projects must comport with the city's Environmental Programme and Climate Strategy. Projects are selected by the City Office and approved by the City Executive Board (City of Gothenburg 2017).

Financing structure:

Gothenburg has issued bonds since 2013. They can be purchased on the capital market by any mainstream investor. In 2013, the first green bonds issuance totalled SEK 500m (€56m); the second, in 2014, totalled SEK 1.81bn (€0.2bn); and 2015 and 2016 issuances amounted to SEK 1.05bn (€0.1bn) and SEK 1bn (€0.1bn), respectively. The total capital raised via financial markets was SEK 4.36bn (€0.46bn)[6] (UNFCCC 2016).

[6] SEK / €currency conversions were calculated according to the historical exchange rates available at the European Central Bank at the end of 2013, 2014, 2015 and 2016: https://www.ecb.europa.eu/stats/policy_and_exchange_rates/euro_reference_exchange_rates/html/eurofxref-graph-sek.en.html

Project outcomes:

Since 2013, Gothenburg has used green bonds to finance 11 projects, including measures for energy-saving traffic lights, electric cars, bicycle infrastructure, sustainable housing, and district heating (City of Gothenburg 2016). Gothenburg was the first Scandinavian city—and the first city in the world—to issue green bonds.

3.3. Debt-based financing: engaging institutional investors

Model overview:

Institutional investors include insurance companies, sovereign wealth funds (SWF), pension funds, mutual funds, and hedge funds, which invest in securities, real property, and other low-risk assets with a long time horizon. As institutional investors become increasingly aware of climate-change risks, their interest in green projects is growing; however, so far the share of climate-friendly investment in the portfolios of EU institutional investors is only 1-2% (Kidney et al. 2015).

Finances from institutional investors can be accessed in several ways. They invest either in publicly listed debt and equity or dedicated investment funds and vehicles, such as an energy-efficiency fund that pools finances from multiple sources for investment in individual projects. Institutional investors can also finance projects directly through debt, equity, public-private partnerships, or other mechanisms (Kaminker et al. 2013). They can participate more easily in projects that include risk-sharing mechanisms, public guarantees and/or co-investment and other incentives from the government (IIGCC 2015).

Projects that can be financed with this model:

Because the primary responsibility of institutional investors is to protect the interests of its own beneficiaries, investments must satisfy certain financial criteria, whether or not they are climate-friendly. To attract mainstream institutional investors, the financial risk/reward ratio of energy-efficiency investments must be competitive without adjusting for climate-related risks (Kidney et al. 2015). Unless bundled for a sufficient investment scale, small-scale projects from individual municipalities will not attract institutional investors.

Advantages:

The model provides access to a very large sum of money from investor groups that prefer to cultivate a positive image and make long-term investments promising moderate growth and low risks.

Disadvantages:

There are still obstacles to larger-scale institutional investment in energy-efficiency measures. For example, energy-efficiency projects are less attractive than other investment options because the heterogeneity of projects and immaturity of the market increases transaction costs and makes energy efficiency less attractive than other investment options. These costs can be reduced through project bundling, as well as through process standardisation (for example, the standardisation of contracts and requirements for monitoring, verification, reporting, project rating, energy performance contracting, and certification). Financial sector regulations may impose additional limitations on energy-efficiency investments.

Jurisdictions that have applied the model:

The London Green Fund is one example of engaging institutional investors into financing street lighting projects.

Case study: London Green Fund (LGF)

Background:

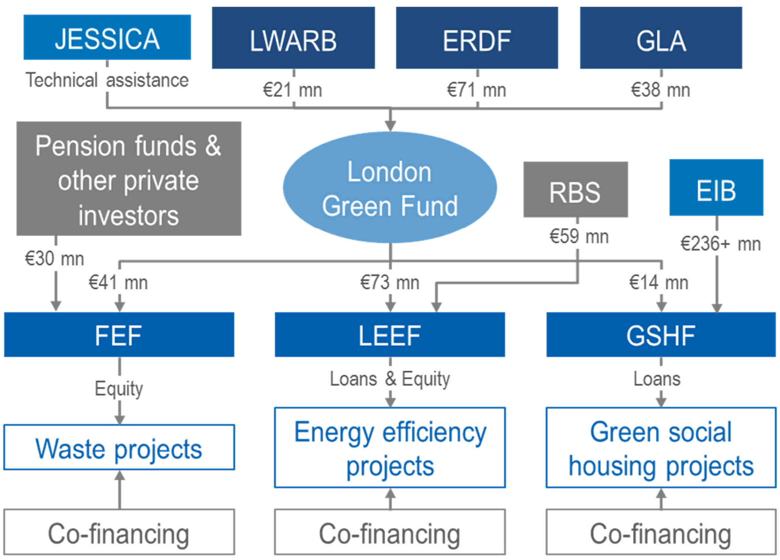
London has set an ambitious goal: limiting its emissions to 60% of 1990 levels. In response to environmental pressure, the city created an Economic Development Strategy intended to improve environment sustainability. One of the city's initiatives to develop green infrastructure, the LGF, was set up with technical assistance from JESSICA (see section 2.2.3 for the definition). It serves as a holding fund for finances from ERDF operational programmes supporting urban development. The LGF has leveraged investments, including those from institutional investors, to increase funds fourfold.

Project timeframe: 2009–2015.

Project scope:

The LGF is a £110m (€130m) holding fund that finances three urban development funds (UDFs): the Foresight Environmental Fund (FEF) for waste management, the London Energy Efficiency Fund (LEEF) for energy conservation, and the Greener Social Housing Fund (GSHF) for more sustainable public housing. These funds also receive direct third-party and private-sector investments. The UDFs finance private- and public-sector projects that, though not yet commercially attractive, are viable and support London's environmental targets (EIB 2015a).

Figure 11: Financing structure of the London Green Fund



Source: EIB 2015a.

UDFs provide loans and equity investments. Depending on the project structure, the LEEF offers loans of £3-10m (€4–12m) (with special provisions for projects less than or exceeding this amount), as well as additional financial instruments. The FEF provides equity, and the GSHF offsets loans to providers of social housing (EIB 2015a).

Financing structure:

The funds in the LGF, totalling €130m, were pooled from three public sources: the ERDF, the Greater London Authority (GLA) and the London Waste and Recycling Board (LWARB). These resources were split between three UDFs. Private investments raised the amount in the three funds to €326m. After the

International Public Partnerships (INPP) contributed €24m in equity investments to the LEEF, the available funding totalled to €480m.

The UDFs are revolving funds. Interest and loans are repaid to the LGF and re-invested in future urban development projects. Setting up a revolving fund to absorb ERDF resources has helped leverage a significant amount of private capital. While the leverage ratio of all public resources is 3.7, the leverage ratio of ERDF funds is 6.8 (EIB 2015a). Figure 10 presents a summary of the financing structure.

Key stakeholders:

- Intermediate body: GLA
- Funding partners: GLA, LWARB
- Private investors: Royal Bank of Scotland, INPP, European Investment Bank (EIB), pension funds, individuals and syndicates
- Holding fund manager: EIB
- UDF fund managers: FEF, Amber Infrastructure Ltd, The Housing Finance Corporation Ltd

Project outcomes:

The LGF currently provides a total of £99.4m (€117m) to finance 15 projects valued at £678m (€800m). Investments are expected to cut CO_2 emissions by 215,000 tonnes/yr., create more than 2,000 jobs, and reduce landfill waste by 330,000 tonnes/yr. (EIB 2015a).

4. Financing by a private contractor

Alternatively, municipal actors can transfer the burden of financing street lighting infrastructure to third parties, for example by contracting an ESCO. The next section focusses on models in which financing is provided by a private partner (e.g., an ESCO) that performs the upgrade but is generally not responsible for the energy supply, which prevents it from using energy savings to recoup its own costs. The private partner finances the street lighting project from its own funds or obtains third-party funding. Municipalities pay the contractor for its services. If the contractor also obtains financing from third parties, it repays its debt to them. Neither the municipal payment to the contractor nor the contractor's payments to the lender are contingent on energy savings.

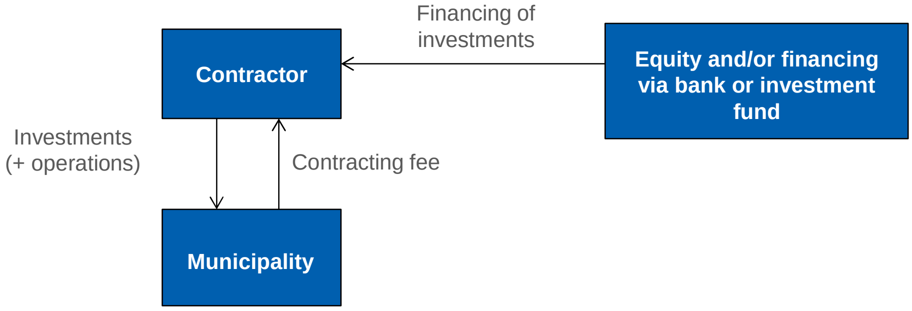
4.1. Simple contracting model

Model overview:

The term 'contracting' is often used to describe a variety of models, including those in which energy savings are reinvested in new, energy-efficient technology for street lighting. Such models are described in the next chapter. The present chapter, however, focusses on models in which funds are provided by a private partner that is usually is not responsible for the energy supply and therefore cannot use energy savings to cover its own costs.

In a simple contracting model (see Figure 12), the contractor may have several responsibilities, but its main activities usually include the planning, financing, and execution of the investment in new, energy-efficient street lighting infrastructure. The contractor may also be responsible for operating this infrastructure, although this is generally not the case for several reasons. First, the city either uses its own resources to operate street lighting infrastructure (potentially including subcontractors), or has contracted an external operator to perform this task, often over a longer period. Such contracts often do not cover the use of new technology for modernisation. As a result, the city must wait until the end of the contract period to issue a new tender including modernisation, or it must find a different partner to carry out the task. Because the time most suitable for the investment rarely coincides with the end of an existing service contract, finding a different partner for the modernisation is often the most practical solution.

Figure 12: Simple contracting model



Source: Authors' own figure.

In a simple contracting model, the contractor receives a contracting fee directly. This fee covers the costs of planning, financing, and executing the investment (providing for a profit). The length of such contracts is generally 10 years or more but may vary in accordance with various factors, including the size of the investment and its relation to energy costs. The contract often must be put out to tender, and there are various evaluation procedures for offers received from vendors. For example, the city may define framework conditions, like the minimum energy savings to be achieved, details about the luminaires to be used, terms of warranty, and performance standards. In addition, the procedure for the end of the contract must be defined. Theoretically, the contractor should be able to remove the luminaires when the contract expires. Due to the long duration of such contracts, however, it is very unlikely that this will take place, because contractors will not be able to sell relatively old luminaires for further use.

Tenders are generally evaluated on the basis of the city's potential savings. Savings can be significant, particularly in countries with relatively high energy prices. In such cases, the contracting fee, which the city pays to the contractor, is often much lower than the energy savings achieved. Maintenance costs are reduced as well, because little upkeep is required for modern LED luminaires.

Projects that can be financed with this model:

Projects must meet minimum size criteria to justify the contractor's participation in the project, which often requires co-financing by a bank. There is no fixed size threshold, but a project volume of €0.5–1m is a reasonable minimum. The value must be raised if the contractor also becomes responsible for carrying out operations, because in this case it must establish an office with personnel and equipment in or near the city.

Advantages:

The key advantage is that the model is off-balance sheet for the city. Contracting models differ from loans in this respect because the latter are normally on-balance sheet for the city. The responsible authority for the city should be asked to verify use of the off-balance model, however. A further advantage is that the tendering process provides an opportunity to select specialised companies that have relevant know-how and experience and offer more attractive prices than those of the city or present operator.

Disadvantages:

From the city's perspective, the major disadvantage of the model is its high financing costs. The capital costs of contracting—whether through equity or re-financing loans from banks—are usually significantly higher than those payable through direct financing from the city's budget or financing models with low interest rates.

Another disadvantage may be restrictions in the availability of grants. This generally varies between specific programmes. For example, until 2017, grants available from the German federal government could not be used in contracting models. From a contractor's perspective, the off-balance sheet financing is a disadvantage, although private investors generally favour off-balance sheet models.

Jurisdictions that have applied the model:

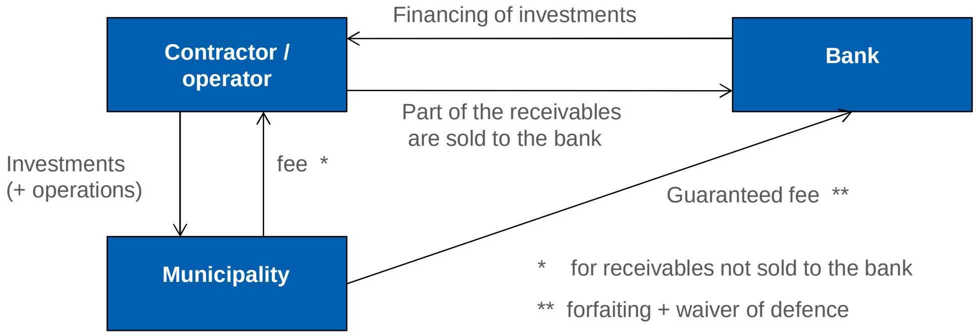
Simple contracting models are widely applied for street lighting projects, although both partners (i.e., the city and contractor) typically search for ways to reduce financing costs by applying more complex models, such as the one described in the following section (4.2).

4.2. Contracting model with forfaiting and waiver of defence

Model overview:

In this more complex model, the city and contractor play roles similar to those in the simple contracting model described above. In contrast to that model, however, here bank involvement is a central element and the bank enters into agreements with the contractor and the city (Figure 13).

Figure 13: Contracting model with forfaiting and waiver of defence



Source: Authors' own figure.

The contractor sells part of its future receivables to a bank in a 'forfaiting transaction'. The city must then pay a portion of the contracting fee to the contractor and another (typically larger) portion directly to the bank, or 'forfaiter'. The portion of receivables sold to the bank corresponds to the value of the equipment installed and is therefore higher than the portion for the planning, installation, and warranty.

The bank participates in the risks arising from uncertainties associated with the receivables and earns a margin. In this particular model, the city may provide a guarantee to the bank, referred to as a 'waiver of defence'. This guaranteed fee minimises the bank's risks, even for the worst scenario (e.g., all luminaires malfunction and no energy is saved). The contractor bears all other risks, including those associated with the equipment.

The contracting model with forfaiting and waiver of defence is therefore a mechanism to generate funds while minimising risks to the bank, thereby reducing the interest rate to a level typically available only to municipalities. The rate reduction may seem modest but can add up to a substantial amount over the long duration of the contract.

As in the previous model, the contractor owns luminaires for the contract term. When the contract expires, there should be an option for the contractor to remove the luminaires. If no such option exists, a leasing contract should be created to regulate any further municipal use of the luminaires.

Projects that can be financed with this model:

There is no big difference to the simple contracting model, as far as minimum project size is concerned. Due to the higher complexity of the model, it might be a bit more difficult to find a bank financing projects below EUR 1 million.

Advantages:

This model has similar advantages to the simple contracting model. Furthermore, contracting with forfaiting and waiver of defence will have a lower interest rate, included in the contracting fee.

Disadvantages:

Although the interest rate is lower than in a simple contracting model, it still is much higher than in the case of financing through models with low interest rate lending programmes, such as the KfW loans currently available in Germany at close to 0 % interest rate.

A further disadvantage is the higher complexity of this model, as well as the fact that a large part of the city's payments, namely the payments to the bank, have to be guaranteed, regardless of the performance of the new street lighting infrastructure.

Jurisdictions that applied the model:

There is limited experience with the application of this model in street lighting so far. We located only two case studies using the model in Central Europe. These are the city of Dillinburg, Germany and the city of Litomyisl, the Czech Republic.

Case study: Dillenburg, Germany

Background:

In 2011, the German city of Dillenburg tendered contracts for a portion of their street lighting services. In the city's street lighting system, a large number of luminaires (73%) used high-pressure mercury (HPM) lamps. Due to the low energy efficiency of the lamps, an EU Directive called for their use to be phased out beginning in 2015. The city of Dillenburg was interested in instituting a contracting model, because the HPM-based streetlights were in urgent need of replacement and budget constraints limited the financing available for replacements in the short term. The main goal was to spread costs over a 12-year period and find a specialist to carry out the modernisation work, while the Dillenburg department of utilities would retain responsibility for operations.

The contract was tendered in 2011 in a process with multiple steps. Bidders were required to present an indicative analysis and general plan. They next submitted a preliminary contract and a detailed analysis and concept, which were used to create the final contract. The final decision was based primarily on the maximum reduction of the city's annual costs, which consisted of the contracting fee and energy costs of the street lighting infrastructure.

Some 70% of receivables were sold by the contractor to a bank, which then became a third partner to the contract to enable forfaiting and the waiver of defence. The 12-year contract began in September 2012, and approximately 2,450 luminaires were replaced in less than three months.

This contract also requires the successful bidder to guarantee a certain level of energy savings (52% minimum) to reduce annual costs. If the contractor achieves higher savings than were guaranteed, it splits the additional savings with the city of Dillenburg. The percentage that would be allocated to each party was considered in the offer evaluation and contributes to the reduction of annual costs. In total, approximate annual energy savings amount to 1GWh (€160,000), much more than the payments to the contractor and the bank.

Project timeframe: 2012–2024.

Project scope: energy efficient modernisation of 2,450 luminaires.

Key stakeholders:

- Client: city of Dillenburg, Germany
- Contractor: SWARCO V.S.M GmbH
- Bank: Commerz Real Mobilienleasing GmbH

Financing structure:

The city used off-balance-sheet financing for the project. The contractor sold approximately 70% of receivables to a bank, which received guaranteed payments from the city over a 12-year period (forfaiting and waiver of defence).

Project implementation and outcomes:

HPM luminaires were replaced with new energy-efficient luminaires in less than three months. The contract is ongoing, but so far, energy savings have been higher than those guaranteed by the contractor. The contractor receives a portion of the additional savings as agreed under the terms of the contract.

Case study: Litomyšl, Czech Republic

Background:

Litomyšl is a town and municipality in the Pardubice Region of Bohemia in the Czech Republic, inhabited by 10,777 people. Because the town is listed as a UNESCO world heritage site, the retrofit of its infrastructure must comply with high energy performance standards as well as with national cultural heritage rules. The municipality issued a tender for an energy performance contract with an ESCO that would upgrade city infrastructure (including street lighting) to provide energy savings, while complying with national heritage preservation standards. The local ESCO, D-energy s.r.o., won the tender and performed the installation work (Paulík email com.).

Project timeframe: 2016–2025.

Key stakeholders:

- Client: municipality of Litomyšl
- Facilitator: PORSENNA o.p.s.
- Contractor (ESCO): D-energy s.r.o.
- Bank: Československá obchodní banka, a.s.

Project scope:

Among other measures, the project replaced four public lighting racks; installed LEDs with night-time dimming in place of 1,225 high-pressure sodium luminaires; and implemented a system of real-time online traffic monitoring and remote control (the first large-scale use of this system in the Czech Republic) (Paulík email com).

Financing structure:

The project was financed off-balance sheet for the city and on-balance sheet for the ESCO, with the ESCO bearing all technical and financial risks associated with the project. The municipality of Litomyšl, the ESCO (D-energy), and the bank (Československá obchodní banka) entered into a 10-year EPC contract, to run from 2016 until 2025. According to the contract, the actual installation work was to be performed in 2014 and 2015 (Paulík email com).

D-energy guaranteed that energy costs for the town of Litomyšl would fall by a minimum of 26.9%. To cover the project investment cost, it obtained a loan from the bank. D-energy sold the bank 97% of future receivables; the payments were made directly from the municipality to the bank from the energy savings guaranteed under the terms of the EPC agreement. Because the bank was assured a 10-year cash inflow from the municipality, it could provide a lower interest rate than would otherwise be the case. This shortened the payback period on D-energy’s investment (Paulík email com.).

Project implementation and outcomes:

The retrofitting of the public lighting infrastructure allowed the city to save approximately €57,000 (54%) on its annual street lighting costs (Paulík email com). Overall, street lighting upgrades accounted for more than half of the energy costs saved under the EPC contract; these savings made other project measures financially feasible.

5. Private-partner financing through energy savings

Energy performance contracts (EPCs) are used to finance municipal infrastructure projects by a private partner, usually an ESCO, through energy savings. There are various EPC models, but the element common to all types is that the costs saved through reduced energy consumption are used to finance the investment. In some EPC models, the municipality may be responsible for the energy supply, while, in others, the private partner may be the responsible party. Ultimately, however, the municipality always pays, in a per-service fee or a lump sum, for the operations, including the energy supply, planning, financing, and installation of the new equipment.

There are several variations of EPC models. First, municipalities can choose between the guaranteed savings EPC model, related payments EPC model, and shared savings EPC model based on the energy savings to be achieved and their division between the contractor (ESCO) and municipality. Next, municipalities can choose to enter into a modernisation contract with immediate energy cost savings or a contract with staggered modernisation. The choice is based on the timing of the upgrades or modernisation, e.g., whether all work associated with the modernisation will take place in the first years of the contract to achieve maximum energy savings, or whether it will instead be performed over time. All four EPC models are discussed in the following sections.

5.1. Variation in defining a contracting fee

5.1.1. EPC guaranteed savings model

Model overview:

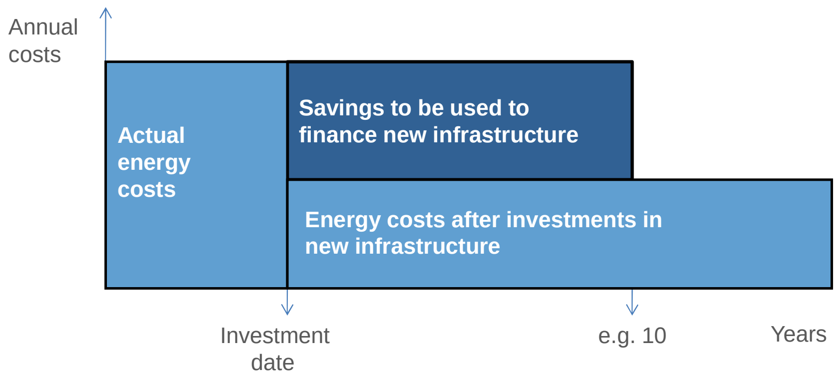
In an EPC with guaranteed energy savings, the ESCO designs and implements the project and is obliged to achieve a certain level of energy savings. If the ESCO fails to deliver these savings, it must cover the shortfall. If the ESCO delivers higher energy savings than guaranteed under the terms of the contract, these savings fully benefit the municipality. Over the contract term, the municipality pays a fixed fee from the cost savings.

Energy savings should, however, be sufficient to pay for the modernisation in a reasonable time. This already shows a potential problem of this model. In countries with low energy prices, the payback period may be so long that it is difficult to attract private partners willing to enter into such contracts. This is the case in some Eastern European countries, where energy prices can fall below 10 EUR ct/kWh[7]. As a result, the duration of EPCs could exceed 20 years, while, in a typical Western European country with energy prices close to or above 20 EUR ct/kWh, much shorter contract lengths are possible.

In the model shown in Figure 14, future municipal costs (consisting of energy costs plus regular payments to the private partner) are identical to municipal energy costs paid before the modernisation took place. When state-of-the-art LED luminaires with ‘intelligent’ controls replace old lighting technology, such upgrades can deliver energy savings of up to 80% or more. In this case, municipalities can use a significant portion of the cost savings to cover EPC fees to the service provider. This arrangement can either shorten the length of the contract or reduce the municipality’s regular payments, allowing for immediate savings even during the contract term (Figure 15).

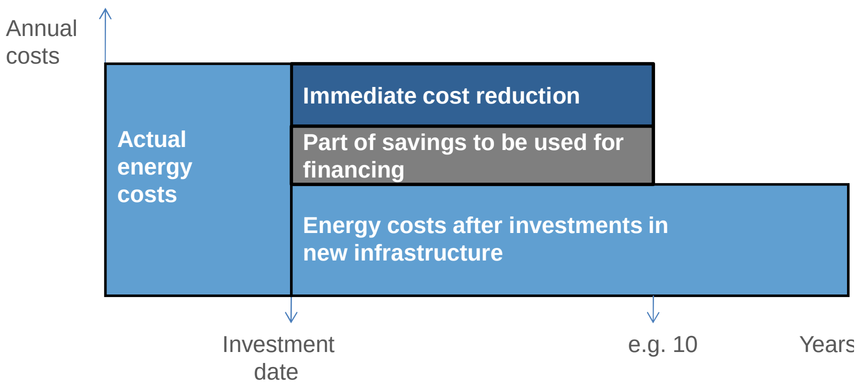
[7] As of September 2017, the electricity price for municipalities was approximately 0.106 EUR ct/kWH in the Czech Republic and 0.092 in Croatia (responses to questionnaire 1)

Figure 14: EPC guaranteed savings model (time-optimised)



Source: Authors' own figure.

Figure 15: EPC guaranteed savings model (with immediate cost reductions)



Source: Authors' own figure.

In all EPC models, the private partner guarantees a certain level of energy savings. This helps the municipality by enabling it to calculate future costs with a high reliability, because the private partner bears the risks associated with achieving the energy savings. There is generally also an agreement to reduce payments to the private partner if it fails to provide the guaranteed savings. While this theoretically constitutes a risk to the private partner, the guaranteed energy savings proposed in its initial offer may include a buffer to absorb such shortfalls.

Projects that can be financed with this model:

This model is suitable for projects with the potential to deliver significant energy and cost savings. Otherwise, the contract duration may be too long to attract private partners. In addition, municipalities should have sufficient financial resources to pay the same amount (or slightly less) over the length of the contract, even though payments are split to cover energy costs and payments to the private partner.

Advantages:

The primary advantage is that the city will receive new, energy-efficient street lighting infrastructure without sharp upticks in public spending. The amount paid by the city over the contract period is equal to or less than the amount that it paid before the EPC; after the contract expires, the city owns energy-efficient infrastructure and benefits from the low operating costs. A further advantage for the city is the fact that the major risks are borne by the private partner.

Disadvantages:

Some disadvantages are indicated above, including those associated with low energy prices and/or the efficiency of the existing lighting infrastructure. In many Eastern European countries, HPS lamps, which emit yellow light, dominate the existing street lighting infrastructure. Relative to those obtained in other areas, the resulting energy savings are lower, though still significant: savings can approach 60%, depending on the age of the technology in use. Unfortunately, this often coincides with low energy prices. Another disadvantage of this model is that it does not incentivise the private partner to reduce energy demand to a level below that guaranteed in the contract. This problem can be solved with the 'shared energy savings' model discussed below (section 5.2).

Jurisdictions that have applied the model:

Berliner Energieagentur GmbH reported the successful application of the EPC guaranteed savings model to complete 10 projects with the Clearinghouse for Energy Contracting in Central and Eastern Europe in 2003–2004, as well as 17 such projects in 2005–2007 with EuroContract Guaranteed Energy Performance (Geissler 2013).

Case study: the province of Huelva, Spain

Background:

The Spanish province of Huelva consists of 79 municipalities, with approximately 520,000 total inhabitants. Most of the municipalities have less than 5,000 inhabitants; some have fewer than 1,000. Public lighting in the province was considered problematic for multiple reasons, including inadequate illumination, inefficient energy consumption, and high costs for energy and maintenance (Diputación de Huelva 2016). Several municipalities of the province tendered their projects in a group and contracted an ESCO based on the EPC guaranteed savings model. This case study presents an example of not only the EPC guaranteed savings model, but also a bundling that may help overcome the barrier of a small project size.

Project scale is a common challenge for municipalities. Relatively small municipalities are particularly affected by this problem, because individual projects in these areas are often too small to attract interest from ESCOs. This challenge can be resolved by bundling projects or implementing a grouped tendering process that incorporates several municipalities. The Provincial Council of Huelva (Diputación Provincial de Huelva (DIPH)) developed and implemented a 'Grouped Tendering Process for the Efficient Management of Public Lighting in Municipalities in the Province of Huelva'. This approach bundles the projects of several municipalities and tenders them as a group.

Grouped tendering offers several advantages. Where municipal resources are limited and projects are small, grouped tendering provides an avenue for municipalities to create economies of scale and thus makes projects more financially viable. By participating in a group tender, municipalities can access services and resources at more competitive prices, enter into shorter-term contracts, and face lower annual fees from service providers.

Project timeframe: 12 years, beginning in 2015–2016.

Key stakeholders:

- Technical assistance and tender management: DIPH
- Technical assistance: Agencia Provincial de la Energia de Huelva [Huelva Provincial Energy Agency (APEH)]
- Nine municipalities in the province of Huelva: Almonaster La Real, Cala, Calañas, El Campillo, Campofrío, Chucena, Jabugo, Puebla de Guzmán and Villarrasa
- Contractor/service provider (ESCO): Gamma Solutions SL

Project scope:

The project improves public lighting infrastructure and services in nine municipalities. Within the scope of the contract, the contractor must replace all lighting with LED technology and energy-efficient controls, monitor installations, install atomic clocks to regulate times of operation, mount all supports, perform all required revisions, and install appropriate grounding systems at all points. Investment projects were assessed and bundled in accordance with three main criteria: the municipality's geographical proximity and links to supra-municipal structures, as well as its investment volume and, finally, its financial solvency.

When the project was initiated in 2012, it had a wider scope. Seventy-eight or seventy nine municipalities were consulted on three main areas: public lighting, public buildings, and renewable energy sources. After three years of assessments and consultations, the final scope was narrowed to public lighting in nine municipalities (Diputación de Huelva 2016). This process indicates the main drawback to this approach: it is extremely complicated to bundle different projects and municipality profiles and to identify a solution that works for all parties.

Financing structure

Grouped tendering presents challenges related to legality, coordination, and liability. The procurement and financing model for the project was selected on the basis of the institution that would serve as the procurement body without the need to set up a new regulatory body. The models under consideration were as follows:

a) DIPH serves as a procurement body;
b) groups of municipalities act collectively as one procurement body, with technical assistance from DIPH;
c) DIPH provides advisory and technical assistance to an association of municipalities (either pre-existing or created for the project);
d) a 'local consortium', operating as a legal public entity, is created to serve as the procurement body, with technical assistance from DIPH;
e) groups of municipalities act as individual procurement bodies but have technical assistance from DIPH.

Option e), presented in Figure 16 below, was selected for project implementation. In this model, municipalities are bundled, with each bundle acting as a separate procurement body. DIPH is assigned the responsibility to issue a call for bids. DIPH acts as a tender manager and develops technical requirements, prepares tender documents, determines award criteria with the approval of each municipality, publishes the calls, and evaluates submitted tenders. Each municipality then signs an individual contract with the ESCO (Diputación de Huelva 2016).

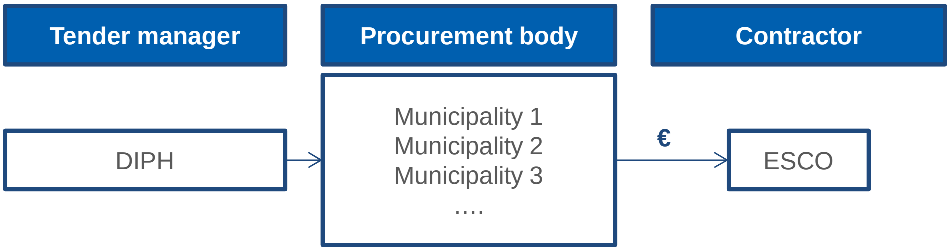
Gamma Solutions SL won the tender for a €7.1m contract (specifically, a 'mixed services and supply contract with an open adjudication procedure') to deliver average energy savings of 72.9%. The agreement, a mixture of an energy service contract and an energy performance contract with guaranteed energy savings, stipulates that the contractor will provide four main services:

- energy management of public street lighting installations;
- preventative maintenance, inspection, and verification;
- full warranty for all repairs or replacements necessary due to acts of vandalism or other external causes;
- improvement and renovation of public street lighting, investment in energy efficiency, and delivery of a certain guaranteed level of savings. If energy savings exceed the guaranteed levels, they are distributed among the participating municipalities.

Project outcomes:

Direct expected outcomes of the project include emission reductions of 5.8 tonnes CO_2-equivalent per year, energy savings of 11.0GWh/yr, cost reductions in excess of €1.7m, and the creation of 100 new jobs. Grouping also allowed the municipalities to obtain better contract terms and realise projects that may not otherwise have been financially viable. In addition, the project generated valuable insights and data on energy service contracting in each municipality (Diputación de Huelva 2016).

Figure 16: Procurement and financing structure of the project bundling in the province of Huelva



Source: Diputación de Huelva 2016.

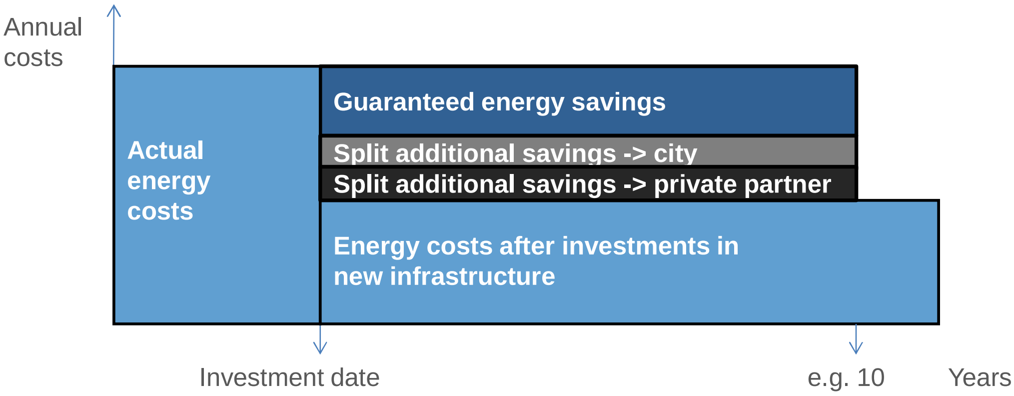
5.2. EPC shared savings model

Model overview:

In this model, the energy savings obtained are greater than those guaranteed under the terms of the contract between a municipality and private partner, and the parties share the additional savings. This is a 'win-win' situation when the contractor and municipality are interested in generating the greatest possible energy savings.

The contract generally specifies a level of guaranteed energy savings, as well as a malus agreement that cuts payments to the private partner if the guaranteed savings are not delivered. In addition, the municipality and the private partner share any savings in excess of the amount guaranteed. The bonus payment to the private partner can be a certain price (in EUR/MWh) or a portion of the saved energy costs, based on an electricity price agreed upon by both partners. This model provides a clear incentive for additional energy savings on both sides, with the savings shared as prescribed under the agreement (Figure 17). The parties may split the savings 50/50, although this is not necessarily the case. In the tendering process, bidders can be instructed to propose a distribution of any extra savings.

Figure 17: EPC shared savings model



Source: Authors' own figure.

Projects that can be financed with this model:

The criteria for EPC guaranteed savings models (see section 5.1) also apply here. The shared savings model is appropriate only if potential energy savings are high; otherwise, the amortisation period is too long.

Advantages:

One major advantage of this model is that both sides have an incentive to consider and realise additional energy savings, even if these were neither planned nor anticipated. Municipalities can invest their share of additional energy cost savings into energy efficiency projects. The model also offers the same advantages as the guaranteed savings model.

Disadvantages:

One problem with EPC guaranteed savings models in which savings are not shared is that they do not incentivise contract parties to realise energy savings above guaranteed levels. Although the shared savings model resolves this problem, it does not mitigate other disadvantages, including the long payback periods that result from low energy prices.

Jurisdictions that have applied the model:

This model is more common than the guaranteed EPC models due to the advantage specified above.

Case study: Nauen, Germany

Background:

In 2010, the German city of Nauen tendered a five-year contract for the operation of their street lighting infrastructure. The infrastructure consisted of approximately 2,350 luminaires, 45% of which were equipped with HPM lamps; the rest were HPS lamps. The city sought to replace all HPM-based luminaires with more efficient technology (not necessarily LED), achieve energy savings of at least 40%, and limit investment due to budget constraints. The city also invited tenders that set alternative targets.

Project timeframe: 2011–2016.

Project scope: modernisation and operation of street lighting infrastructure

Key stakeholders:

- Customer: city of Nauen, Germany
- Contractor: SWARCO V.S.M. GmbH

Financing structure:

Several bids were received and evaluated based on the total operating and investment costs. The winning bidder presented the city of Nauen with two offers, one for a period of five years, and the other for 10 years. Although the first bid guaranteed energy savings of at least 43%, it proposed few measures to modernise infrastructure and did not include LED technology. The second bid incorporated more advanced technology that would generate energy savings of at least 47%. After considering all offers in the context of the existing budget, the city decided to accept the first offer, mainly because of the lower investment costs.

The city also wanted to retain the option to invest in more efficient lighting technology in future, as the city's budget allowed. As a result, it negotiated a 50/50 split with the private partner for any energy savings exceeding the 43% guaranteed. Based on an electricity price per kWh, established at the beginning of the contract, any additional energy savings were measured once a year, with 50% paid to the private partner. As a result of this agreement, the city was able to invest additional funds into energy efficient technology, reflecting the 'win-win' character of the model.

Project implementation and outcomes:

The private partner responsible for operating and the modernising the infrastructure improvements achieved slightly higher energy savings than guaranteed. It received additional payments in accordance with the terms of the contract, which stipulated that it would split any excess energy savings evenly with the city.

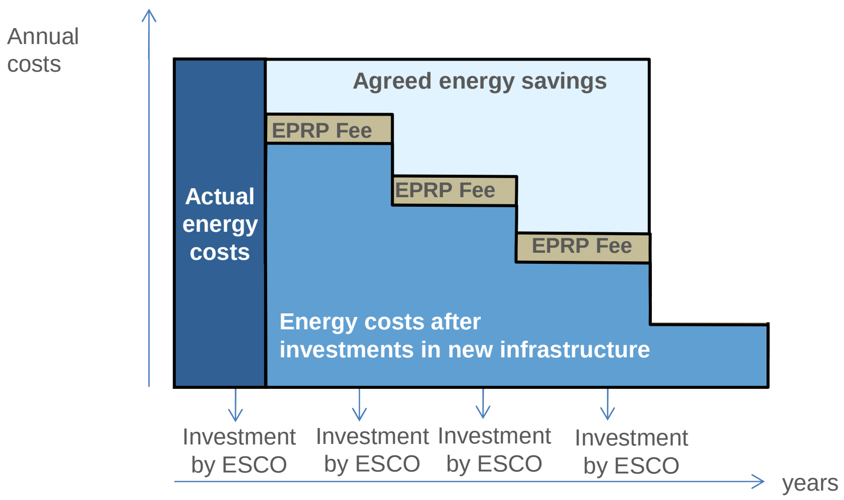
5.3. Model with related payments

Model overview:

Under an Energy Performance Related Payment (EPRP) contract, an ESCO guarantees to improve the energy efficiency of street lighting infrastructure with guaranteed savings for an agreed fee. The fee is contingent on energy savings, which means that if savings fall short, the ESCO loses a portion of its fee (SEAI, n.d.).

An EPRP contract specifies guaranteed energy savings, sets a fee, and establishes a payment mechanism for measured and verified savings (see Figure 18). The EPRP model can be added as a clause to traditional contracts or tender documents as a guarantee that the project will fulfil its intended objective in a way that improves energy efficiency. The performance risk is shared between the municipality and the ESCO (SEAI, 2014). The contract generally expires 12 months after the work is complete. After this point, the vendor is unlikely to finance the infrastructure.

Figure 18: Sample EPRP model



Source: Authors' own figure.

Jurisdictions that have applied the model:

Multiple case studies of the EPRP model are located in various parts of Ireland. For example, the Port of Cork and the Dublin Port headquarters have applied the model to lighting infrastructure (SEAI 2014).

Advantages:

Payments based on energy efficiency lead to a more accurate quantification and verification of energy savings. The objectives of the ESCO align with those of the municipality objectives, because the ESCO focusses on the energy performance of the upgrade. Because of the related payments to energy savings, funding for such projects is more easily accessible (SEAI 2014).

Disadvantages:

Like the staggered modernisation model, the EPRP prevents the city from realising early cost savings, because some of the upgrades are performed at a later stage.

Projects that can be financed with this model:

This model, like the previous EPC models, is best suited to projects with the potential to generate significant energy savings.

Case study: County Carlow/Kilkenny, Ireland

Background:

County Kilkenny, located in southeastern Ireland, has nearly 100,000 inhabitants, of whom approximately 25,000 reside in urban areas. Street lighting accounts for roughly 55% of the county's electricity consumption. Despite the area's variable and unsatisfactory street lighting, the county struggled to finance the high upfront costs of an upgrade. The objective of the project is to replace the existing street lighting with LED technologies, while taking into account the potential impact of the aesthetics on the area's historical character and tourism. The county intends for its efforts to support the country's objective (as stipulated in the National Energy Efficiency Action Plan) to reduce Ireland's energy consumption by 33% by 2020. This project decreases energy use by 700MWh/yr, contributing a reduction of 3% to the 2020 reduction target (Keogh email com.).

Project timeframe: 2017-2023

Key stakeholders:

- Client: Municipal Council of County Kilkenny
- Contractor: Airtricity Utility Solutions (AUS)
- Additional public funding was provided through a grant from the Sustainable Energy Authority of Ireland (SEAI).

Project scope:

There are 9,800 light points in County Carlow/Kilkenny. The project covered the upgrade of 1,300 street lights on regional roads and housing estates in 2017 (Keogh email com.).

Financial structure:

The total investment cost of €600,000 was paid in 2017. The municipality successfully applied for and obtained a SEAI grant that covered 30% of the total investment costs. While the municipality provided €420,000 from its own funds and created an internal ESCO, the contractor provided €225,000 in the form of an energy performance bond. The value of the bond cover was calculated as 50% of the guaranteed energy savings (approximately €90,000 per year) over five years. If the guaranteed savings are achieved, the bond can be reduced each year by an amount equal to 50% of the guaranteed savings. If the guaranteed savings are not achieved, the bond will only be reduced by 50% of the actual value saved. In this case, the term of the bond will need to be increased. On the other hand, if the actual savings exceed the amount guaranteed, the term of the bond will be shortened accordingly. Maintenance costs are not included in the energy performance contract, but these costs fall as the bulb lifespan increases to 100,000 hours (Keogh email com.).

Project implementation and outcomes:

The total electricity capacity, as well as the annual electricity consumption and costs, fell by approximately 65%; annual maintenance costs decreased by 82%.

5.4. Variation in the timing of modernisation

5.4.1. Model with immediate energy cost savings

Model overview:

Improvements in new, energy-efficient street lighting infrastructure can be completed over a few months, unless the total volume is too large. A slightly longer period may be necessary but should be as short as possible so that energy savings can be achieved as quickly as possible. The EPC model can provide for guaranteed savings only or shared savings.

Projects that can be financed with this model:

Models that call for immediate modernisation (i.e., the replacement of old luminaires with new, energy-efficient luminaires in the shortest possible time) are appropriate if all existing luminaires are old and no longer acceptable in terms of their energy efficiency, reliability, and maintenance costs.

Advantages:

The primary advantage of this model is that it allows for maximum energy savings. In addition, because new technologies—including LED lamps in particular—require less maintenance, the associated costs are lower. This should be reflected in the price offered by the private partner.

Disadvantages:

If the city covers all modernisation costs, the sizable initial investment may be prohibitive. The terms of the agreement also require the city to tolerate extensive construction activity at one time. The city must consider the consequences (for example, with regard to traffic congestion and public reaction), particularly if the planned replacement will affect poles as well as luminaires.

In long-term contracts, the early realisation of savings means that, by the time the contracted work is complete, the entire street lighting infrastructure is once again outdated and must be replaced. The modernisation process completed over the contract period will not incorporate any new technology; this prevents the city from modernising infrastructure at a constant rate (cities typically modernise 3% of existing infrastructure per year with the most advanced technology). All luminaires will be modernised at the same time, regardless of age, even though the condition of some may still be acceptable. The staggered modernisation model (see section 5.3.2) eliminates these disadvantages by providing for time-optimised (i.e., longer-term) modernisation and utilisation of energy savings.

Jurisdictions that have applied the model:

The EPC guaranteed savings model with immediate energy cost savings has been implemented in several European cities. For instance, the city of Tona, Spain, used the model to upgrade a total of 2,025 luminaires and install a remote-control system in 2012; this system generated an annual savings of €58,966 (GuarantEE 2017b). The Bulgarian municipality of Sapareva Banya replaced 1,381 lamps with LED lights in 2015 and 2016, realising €93,335 per year in energy cost savings (GuarantEE 2017c).

Case study: Graz, Austria

Background:

The Austrian city of Graz has 25,000 luminaires, of which more than 700 were upgraded in 2005 as part of project Green Light 1. Most of the existing luminaires dated from the 1960s, resulting in high annual energy costs of €1.1m (including tax). In 2007, after the successful completion of the pilot project, the city of Graz implemented a similar project on a larger scale. The new initiative, Green Light Graz 2010, upgraded 18,000 luminaires within three years (Energie Graz GmbH & Co KG 2010; GuarantEE 2017a). The city sought to implement the energy efficiency measures as quickly as possible so that it could maximise the energy and cost savings.

Project timeframe: 2007–2010

Project scope:

The existing 18,000 luminaires were replaced with energy-efficient HPS vapour lamps. In addition, the city installed aluminium die-cast luminaires with IP protection class 66, reflectors, and easy shutters for bulb replacement, and implemented a control system for switching on and dimming the lights.

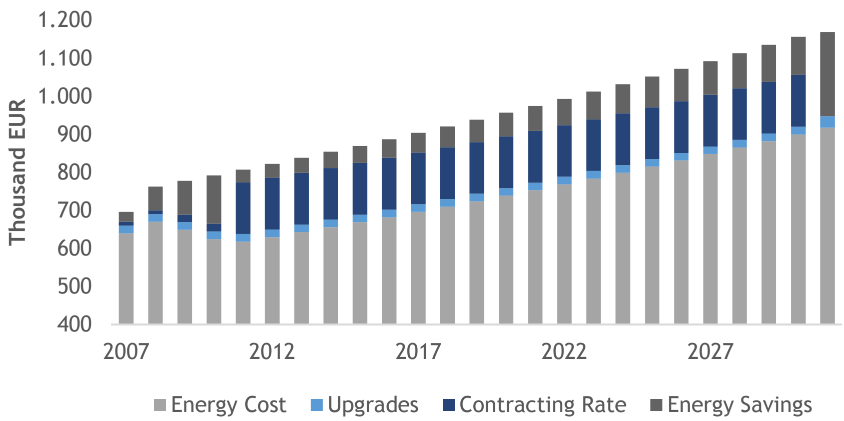
Key stakeholders:

- Contractor (ESCO): Energie Graz
- Customer: City of Graz
- Project manager: Grazer Energieagentur [Graz Energy Agency]

Financing structure:

The project was financed through the Thermoprofit EPC Programme, an initiative designed and implemented by the City of Graz and Grazer Energieagentur. The City of Graz commissioned Grazer Energieagentur to design the contract, as well as to oversee and provide general management for the project implementation. The local utility providing service and maintenance of street lighting, Energie Graz, served as an ESCO and was contracted by the City of Graz to develop the technical design of the street lighting upgrade and to finance and implement the project.

Figure 19: Annual costs and benefits of the Green Light Graz 2010 project[8]



Source: Energie Graz GmbH & Co KG 2010; Grazer Energieagentur 2010

[8] Costs and benefits of the upgrade depend on projected electricity prices (which were very low in 2010), the timeframe within which accrued interest is paid, and the lifespan of the light bulbs. Therefore, actual costs and benefits may differ from initial estimates.

Programme investment costs were €2.3m. Energie Graz guaranteed the City of Graz that it would reduce energy consumption by 20%; as of 2011, energy use had decreased by 24%. The City of Graz agreed to pay Energie Graz a 20-year fixed monthly contracting fee, which totalled €172,560 per year. The budget for the City of Graz benefitted immediately from the saved energy costs, which, at €220,000 per year, exceeded the contracting fee (Energie Graz GmbH & Co KG 2010; GuarantEE 2017a).

Project implementation and outcomes:

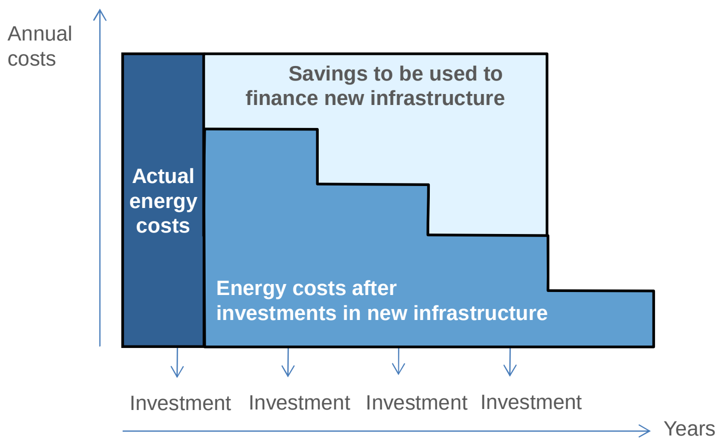
All street lighting infrastructure had been upgraded by 2010. The contract period expires in 2027. The costs and benefits of the project are presented in Figure 19.

5.4.2. Staggered modernisation model

Model overview:

The staggered modernisation model (see Figure 20) addresses the disadvantages of the previous model by extending the modernisation process over a longer time period. Over several years or even decades, outdated luminaires are replaced with new, energy-efficient luminaires. At regular intervals during the contract term and again at the end of contract, the city and private partner can establish a modernisation time schedule or specify the maximum age of luminaires (and poles, if these are included in the modernisation programme).

Figure 20: EPC staggered modernisation model



Source: Authors' own figure.

Projects that can be financed with this model:

Models with staggered modernisation are appropriate in cases in which age and lighting technology vary among existing luminaires. Under these circumstances, it makes sense to replace the oldest and least efficient luminaries first, and wait with other luminaries until their technical and economic performance indicates that they have reached the end of their useful life.

Advantages:

The advantage of this model is that it provides for more regular investments. As a result, the city maintains reasonably modern street lighting infrastructure, and there are no sharp upticks in investment requirements or building activity. The model also helps to prevent a situation in which all luminaires are replaced at the same time. The least energy-efficient luminaires can be replaced first.

Disadvantages:

The primary disadvantage is that the city realises the benefits of energy savings and lower maintenance costs later than it would if it applied the immediate savings model (see section 5.3.1).

Jurisdictions that have applied the model:

This model has been implemented successfully in Germany.

Case study: Hilden, Germany

Background:

In 2014, the city of Hilden tendered a 20-year contract. The winning bidder would be tasked with all operations, including the supply of energy, upgrade of more than 5,000 luminaires (the vast majority), and modernisation of roughly 2,400 poles.

One of the primary conditions of this contract required the parties to specify, at fixed intervals (after five, 10, 15 and 20 years), the maximum average age of the luminaires, as well as the maximum age of any one luminaire or pole. Electricity costs were split between the private partner, which would finance direct costs, and the city, which was responsible for indirect costs, including taxes, dues, and grid access costs. Under this arrangement, both partners would benefit from energy savings. Bidders were asked to which luminaires to modernise and at what time, taking into account the age restrictions. Tenders were assessed on multiple criteria, including the total price over the 20-year period and various organisational and technical factors. The contract took effect on 1 January 2015.

Project timeframe: 2015–2034.

Project scope:

Operations management, including the supply of energy, as well as the modernisation of almost all luminaires and roughly half of the poles.

Key stakeholders:

- Customer: City of Hilden, Germany
- Contractor for operation and modernisation: SWARCO V.S.M. GmbH

Financing structure:

Payments are made by the city, but it recoups indirect costs in the form of energy savings. Direct energy costs are covered by the private partner.

Project implementation and outcomes:

The project is still in its initial phase, but modernisation is already underway, in accordance with an optimised time schedule for the entire 20-year period.

6. Public-private partnerships other than EPCs

In recent years, public and private actors have created new types of infrastructure contracts. These actors enter into contracts to share responsibilities associated with infrastructure project implementation and/or operations management (ESCAP 2008). These models are referred to as 'public-private partnerships' (PPPs). The technical and financial specifications of these models vary greatly. EPCs, discussed above, are one form of PPP. Leasing, concession, and private finance models, outlined below, are other PPPs used throughout Europe to upgrade street lighting infrastructure.

6.1. Sell- and leaseback model

Model overview:

A party leases an asset when it grants another party (the 'lessee') the temporary right to use san asset without purchasing it. Sale-and-leaseback models are often used to finance the upgrade, operation, and management of street lighting for a certain amount of time. Under this model, a municipality sells street lighting infrastructure to a private contractor conditional on upgrade, operation, and management. The municipality than leases it back from a private contractor for a fixed fee over a set period of time. Ownership rights are generally transferred back to the municipality at the end of the leasing contract.

Projects that can be financed with this model:

Leasing is appropriate when upfront investment costs for a project are too high for the municipality to self-finance.

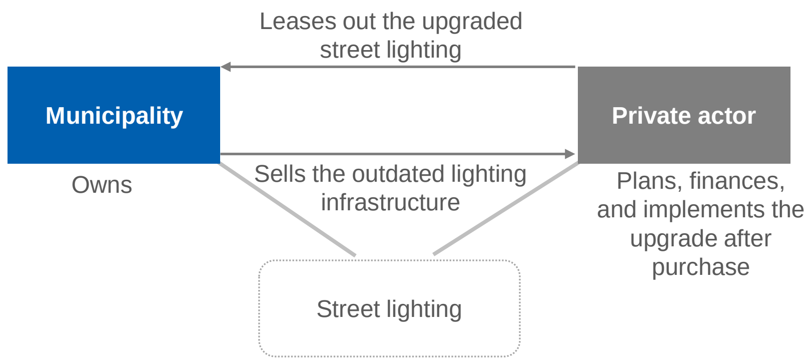
Advantages:

When property is leased, the owner bears the investment costs; the municipality reaps the benefits of upgraded infrastructure without increasing its debt. Depending on the specific provisions of the leasing contract, the municipality may be permitted to repay the lease with the savings generated by the upgrades (The Climate Group 2013). The financial risks and costs are spread out over time.

Disadvantages:

Partners to a leasing contract share the risks related to asset performance and maintenance, but the municipality has less control over the assets. In the long term, leasing is costlier than self-financing.

Figure 21: Sample leasing model between a private partner and a municipality



Source: Authors' own figure

Jurisdictions that have applied the model:

The leasing model is not common in Europe but has been implemented in the Italian municipalities of Cesena (see below) and Martignacco. It has been applied by multiple jurisdictions in the United States, including in Pennsylvania and Texas (The Climate Group 2013). The city of Guadalajara, Mexico, has recently used the leasing model, combined with governmental support, to upgrade its street lighting (Makumbe et al. 2016a).

Case study: Cesena, Italy

Background:

The Municipality of Cesena is situated in the province of Forlí-Cesena in the Emilia-Romagna region of Northeast Italy. As of 2015, Cesena had a population of approximately 97,000. The Public Construction Department manages municipal lighting services in Cesena. The department is responsible for monitoring service quality, including by tracking energy savings and optimising the network to comply with current regulations. In addition, the municipality oversees investment in new public lighting plants and infrastructure and sets new standards for quality, innovation, and service delivery.

As of January 2015, the municipal street lighting infrastructure of Cesena includes a total of 21,000 light points. The total installed capacity is roughly 2,780MW; annual electricity consumption is 11GWh. The municipality's objective is to decrease energy consumption by 30–40% and increase the quality of lighting in public spaces, for example by replacing all existing street lighting installations with LED technology (Burioli email com.).

Project timeframe: 2015–2027.

Project scope:

Under an agreement signed in 2010 and renewed in 2015, the municipality of Cesena transferred the ownership and management of the majority of its 21,000 light points and traffic lights to Hera Luce Ltd. In accordance with the agreement, Hera Luce Ltd, a private contractor specialising in management of public lighting installations, assumed ownership of 15,830 light points, while 5,236 remained municipal property (Burioli email com.).

Key stakeholders:

- Implementing agency: Municipality of Cesena
- Contractor: Hera Luce Ltd

Financing structure:

The first project undertaken by Hera Luce Ltd was a €2.3m initiative that replaced the most outdated lights with LED luminaires. The project, completed by April 2017, upgraded 4,880 light points in the municipality (Emilia-Romagna Region 2017; Gallesi 2017). A second agreement took effect in 2015 to update 15,830 light points (Burioli email com.). For the light points under its ownership, Hera Luce Ltd does the following:

- performs ordinary and extraordinary maintenance of street lighting networks and public electrical installations;
- constantly monitors the state of the network and manages emergency services as needed in the event of a malfunction;
- implements technological improvements and energy saving solutions.

In collaboration with the municipality, Hera Luce Ltd is also responsible for preparing an investment plan for modernising the lighting network. In accordance with the investment plan, the company is currently carrying out a full upgrade of all of its light points.

For the length of the project period, the Municipality of Cesena will lease the light points owned by Hera Luce Ltd for a fee. After 2027, the Municipality of Cesena will regain ownership of these light points. The city invests directly in the 5,236 municipally-owned light points, but these require a smaller investment. (Burioli email com.)

Project implementation and outcomes:

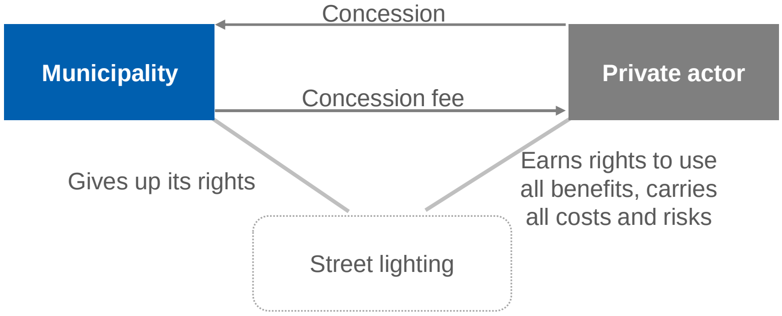
This model allows the Municipality of Cesena to engage a private investor, Hera Luce Ltd, to finance efficiency upgrades to the public lighting network in accordance with the contract terms and the investment plan prepared by Hera and the municipality (Burioli email com.).

6.2. Concession to a private partner

Model overview:

Under a concession model, the municipality commissions a private partner ('concessionaire') to operate and maintain street lighting infrastructure over a set period. The municipality pays the private operator a fee for this service. To cover costs, the private partner can use its own funds or raise debt in the capital market and invest the balance in energy-saving measures. By using these funds to reduce the costs of operation and maintenance, the contractor can accrue revenue. In response to Directive 2014/23/EU (26 February 2014) on the award of concession contracts (European Commission 2014b), each EU member state implemented national legislation regulating tenders for concession contracts. Figure 22 presents a simplified model of a concession agreement between a municipality and a private partner.

Figure 22: Sample concession-based model between a private partner and a municipality



Source: Authors' own figure.

Projects that can be financed with this model:

Any municipality can outsource the operation and maintenance of its lighting infrastructure to a private-sector company by drawing up a concession agreement in line with the legislation of the respective national government.

Advantages:

Under a concession contract, a private company is responsible for operating and maintaining municipal lighting infrastructure. It also must invest in upgrades and bear associated investment risks, including those related to technical aspects of implementation. Another potential advantage to the municipality is that it can stimulate innovation by setting high energy efficiency standards in the tender for contracts (ESCAP 2008).

Disadvantages:

Setting up and administering a concession model can be complicated. In particular, the negotiation and tendering phases may require significant manpower and time. Therefore, the transaction costs can be substantial. In addition, once the contract is signed, close regulatory oversight is required (ESCAP 2008).

Jurisdictions that have applied the model:

In the EU, concession models have been implemented in the northeastern Italian municipality of Azzano Decimo (Mazzolini email com.) and in Paris, France (see below).[9]

Case study: Paris, France

Background:

Public lighting is the second-largest source of energy consumption in Paris. The city has a total of 175,000 public light points[10]; 30,000 lighting consoles; 21,000 traffic lights; and 63,000 traditional street lights (candelabra) (Paris 2015). In 2011, the City of Paris entered into a concession agreement with a consortium of companies (‘EVESA’) for the operation and maintenance of Paris street lighting.

Project timeframe: 2011-2021

Project scope: All street lighting within the municipality of Paris

Key stakeholders:

- City of Paris
- Concessionaire: EVESA, a consortium of companies named for its participants: ETDE, Vinci, Satelec, and Aximuim

Financing structure:

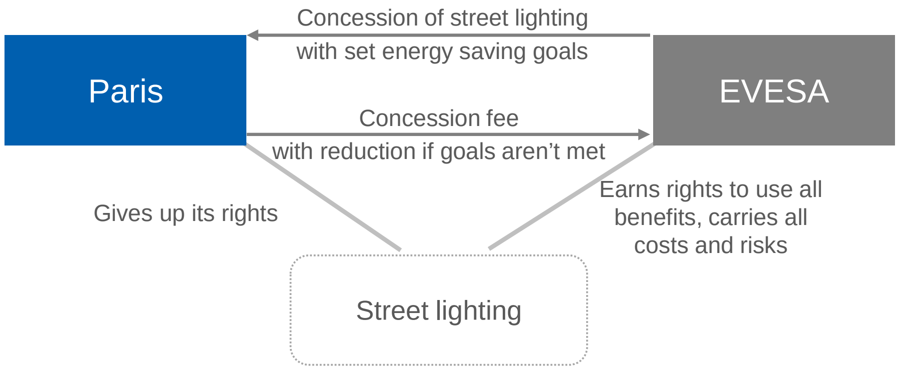
The City of Paris issued a tender invitation to the private sector for a concession contract of nearly €450m (excluding VAT) in concession fees and selected the best candidate, EVESA, from among several applicants. For the duration of the contract, the city transferred to EVESA the right to operate and maintain public street lighting and traffic lighting, along with the responsibility to provide technical support for large development projects and assist in project management and asset management (including in the event of vandalism, the replacement of identical facilities, and renovation of the substations and network). The terms of the agreement required EVESA to guarantee energy savings of 42GWh over 10 years (Duguet email com.). As the concessionaire, EVESA incurs financial penalties if it fails to deliver these energy savings (see Figure 23) (Duguet email com.).

Concession fees are financed from the city’s local budget, i.e. its budget for lighting infrastructure, including operations and maintenance, project management, renovation, and public asset management.

[9] For further information, including the number of municipalities in Brazil using this model, see (WBG 2016a).

[10] Paris street lighting statistics include traffic lights, lighting in public spaces (e.g., squares or roads), and illuminated sites (e.g., buildings and monuments).

Figure 23: Structure of the concession agreement for street lighting in the municipality of Paris



Source: Authors' own figure.

Project outcomes:

The City of Paris set a goal to reduce its GHG emissions by 75% between 2004 and 2050. To advance the city's progress towards this target, EVESA seeks to reduce street lighting energy consumption by 30% by 2020. To do so, it intends to refurbish one third of all lights within the contract period (EVESA 2014), including by replacing 20% with LED technology (Duguet email com,). The project has already had a significant impact: between 2011 and 2014, urban lighting emissions decreased by 24% (EVESA 2014).

6.3. Project finance

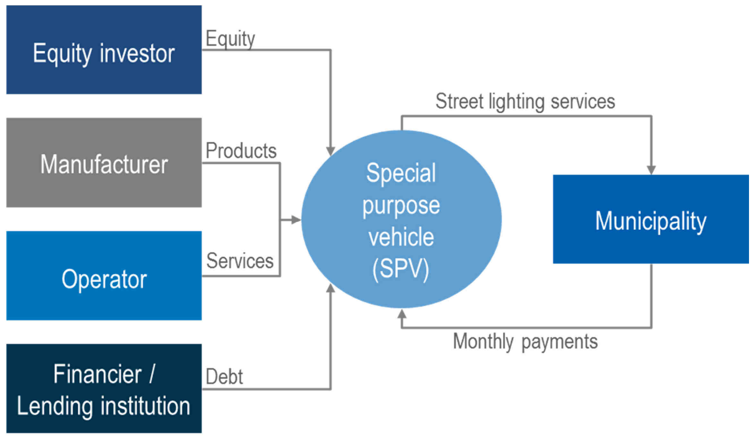
Model overview:

The project finance model is another method by which municipalities can leverage limited public funds and raise private capital for PPP projects. The project participant creates a special purpose vehicle (SPV), a subsidiary legal entity that facilitates financial objectives while minimising the parent company's risk exposure. Its balance sheet documents project expenditures (Figure 24). The SPV is financed through equity from private investors, debt from lending institutions, and contributions from the municipality (De Marco et al. 2016). Project finance has been implemented successfully for large transportation and energy infrastructure projects (Esty and Sesia 2010). There is growing interest in this model, and its use for urban-scale energy efficiency projects is becoming more common; however, to date, there is no standardised approach to its implementation (Limaye and Limaye 2010).

SPV arrangements include one or several private sector partners, such as equity investors, manufacturers, debt providers, and asset operators. The SPV is responsible for designing, installing, operating and managing street lighting infrastructure at its own expense for the life of the contract. During this period, partners from the private sector bear most risks associated with asset ownership (De Marco et al. 2016).

Contract terms are generally 20–25 years. The contract price is based on the required investment, cost of capital, and operation and maintenance costs. The municipality pays private-sector partners monthly unitary charges, the amount of which is based on the contract price. These payments represent the key security for funders (Scottish Futures Trust 2013; WBG 2016b).

Figure 24: Structure of sample SPV model



Source: Authors' own figure.

Projects that can be financed with this model:

The project finance model is suitable for large projects with capital costs exceeding approximately €20m. The projects must be able to attract private investors to ensure financially sustainability. Financial sustainability depends on the revenues and profit realised over the contract term and is linked to the credit profile of the municipality. Supporting public financing tools like grants, tax exemptions, tax-free bonds, or credits can significantly improve project viability and facilitate private-sector involvement. The project finace model also allows for long-term contracts with private actors for the operation and maintenance of street lighting assets (Scottish Futures Trust 2013). The simple regulatory structure, clear legislative provisions, and fast, transparent bidding process are prerequisites for successful project implementation (Mendoza et al. 1999; Spillers 2000; De Marco et al. 2016).

Advantages:

The primary advantage of this model for municipalities is that it provides an opportunity for them to leverage private capital and implement projects using off-balance financing. The off-balance structure is also an important advantage for investors, manufacturers, and operators. From the perspective of both the public and private sector, one major advantage is that the SPV isolates project risks, enhancing the attractiveness of the investment. Long-term contracts provide stability for operations and asset maintenance (De Marco et al. 2016; Link 2012). An additional benefit for municipalities is that, if private-sector partners fail to supply the services as agreed in the contract, the municipality is entitled to deduct or withhold a predetermined amount from payments and can even impose penalties.

Disadvantages:

The main challenge in using the project finance model is absorbing the high transaction costs associated with preparing and implementing the SPV. This model is not suitable for small projects. Creating a consortium of several municipalities can increase project scale to the level required for a SPV; it also diversifies investment portfolio and risks. However, the governance and structure of the consortium involve additional costs. The project finance model may also allow a long time to elapse between the project start date and the beginning of actual development (De Marco et al. 2016; Bonetti, Caselli, and Gatti 2010; Makumbe et al. 2016).

Jurisdictions that have applied the model

The project finance model has been widely used for street lighting investments across the United Kingdom (UK) in Private Finance Initiative (PFI) and Private Finance 2 (PF2) projects. As of March 2016, 32 UK jurisdictions had applied SPV models for street lighting infrastructure investments with an average capital value of £45m (€57m)[11] (HM Treasury 2016).

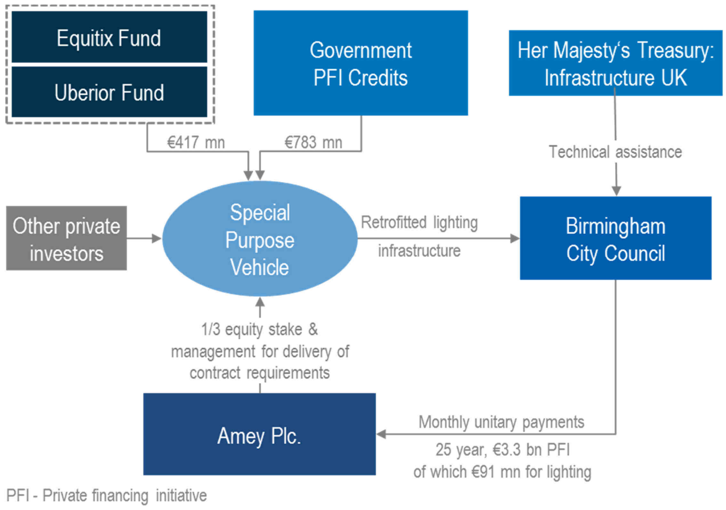
The project finance model is also common in Italy, where it has been used by municipalities including Udine, Codroipo, Spilimbergo, Mereto di Tomba, and Morsano al Tagliamento (Mazzolini email com.).

Case study: Birmingham, UK

Background:

The Birmingham LED street lighting project is part of a larger PPP venture to modernise the city's streets, roads, tunnels, and other assets under the framework of the Birmingham Highway Maintenance and Management Private Financing Initiative (HMMPFI), implemented in 2007–2035. The project was implemented under the Private Financing Initiative (PFI), which provides national government support in the form of credits or grants to facilitate private-sector investment. Birmingham's Sustainable Community Strategy 2026, adopted in 2008, was an additional driving force for implementation of the energy-efficient LED street lighting programme. The total value of the HMMPFI is £2.6 billion (€3.3 billion), of which approximately €91m is allocated to lighting (Makumbe et al. 2016a). The structure of the Birmingham LED street lighting project is presented in Figure 25.

Figure 25: Simplified structure of Birmingham LED street lighting project



Source: Makumbe et al. 2016a

Project timeframe: 2007–2035.

Project scope:

The Birmingham LED programme for efficient street lighting is an initiative to upgrade, maintain and manage the operation of 97,000 streetlights. The programme became Europe's first LED streetlight

[11] Here and below, currencies are converted to the euro on the basis of the exchange rate as of 31 March 2016, published by the European Central Bank, with GBP 1 = €1.2633. (https://www.ecb.europa.eu/stats/policy_and_exchange_rates/euro_reference_exchange_rates/html/eurofxref-graph-gbp.en.html)

project to use the project finance model. The programme is expected to save up to 50% of annual energy costs, reducing energy expenditures by as much as £2m (€2.5m) (Makumbe et al. 2016a).

Key stakeholders:

- Implementing agency: Birmingham City Council
- Equity and service provider: Amey Plc
- Private investors: Equitix Fund, Uberior Fund Investments, and other financiers
- Technical assistance: Her Majesty's Treasury, Infrastructure Fund
- PFI credits: UK Government

Financing structure:

The Birmingham City Council contracted Amey Plc to operate as the main service provider for 25 years. Infrastructure UK (IUK) served as the technical adviser on the structure of the PFI deal.[12] A SPV was created for project implementation with oversight by the Birmingham City Council and Amey Plc. The total project was valued at £2.6 billion (€3.3 billion), with approximately €91m earmarked for lighting. This includes £620m (€783m) of PFI credits from the UK government in the form of a grant and £330m (€417m) from Lloyds (Uberior Fund) and Equitix investment funds, as well as financing from investors and debt providers (Makumbe et al. 2016a).

Over the life of the contract, the Birmingham City Council pays Amey Plc monthly unitary charges for the initial investment and for the costs of maintenance and operations. For the first five years of the contract, an independent certifier approves increases of roughly 4% in monthly unitary charges. The contract allows the city to make a deduction from the payments under specific circumstances (Makumbe et al. 2016a).

Project implementation and outcomes:

The LED programme for efficient street lighting was implemented in two stages. The core investment (replacement of 57,404 luminaires) was made in the first five years and the rest of the luminaries are updated in the following twenty years. All assets are operated and maintained over the contract period of twenty five years. Through the SPV, Amey Plc. is responsible for selection, purchase, installation and maintenance of LED luminaires. It takes the full asset technology and performance risks. Birmingham City Council can audit the performance of Amey Plc.

The final investment outcomes are not yet known. Nevertheless, the programme is already considered a successful example of an infrastructure modernisation project that is financed by private capital, relieving the municipality of the responsibility to supply all upfront capital on its own. Key drivers of the project success are availability of national framework or support such as the PFI credits, availability of technical assistance to make sure the contract is well structured and clear municipality policy priorities.

Case study: the cities and municipalities of Krapina-Zagorje and Zagreb counties

Background:

Krapina-Zagorje and Zagreb counties surround the capital of Croatia, Zagreb, and account for 11% of the total country's population. This region, located in central Croatia, is at a crossroads of major roads, railways, and pipelines. It is also the country's industrial core. As part of a package of energy strategies

[12] Infrastructure UK (IUK) was a body within Her Majesty's Treasury which focussed on long-term infrastructure priorities and facilitated private-sector investment. It was also responsible for supporting and providing guidance on PFI implementation. In November 2015, it was announced that, in 2016, IUK would merge with the Major Projects Authority (MPA) to create the Infrastructure and Projects Authority.

and action plans for these counties, the North-West Croatia Regional Energy Agency (REGEA) developed a master plan for street lighting. The plan includes an assessment of the potential technological and economic benefits of efficient street lighting and identifies financing options for street light retrofits. The agency also devised an energy audit methodology for individual street lighting projects. The NEWLIGHT project aims to facilitate the implementation of the master plan and complete the retrofit of public lighting infrastructure.

The NEWLIGHT project assists municipalities in preparing a) tender documents to select a contractor for energy audits; b) energy audits, including a detailed energy assessment of public lighting status quo for all self-government units; c) the design of public lighting system upgrades, including with regard to technical factors, and guidelines ('action plans') for implementation; d) tender documents to select a contractor that will use innovative financing mechanisms to implement these upgrades. The financing mechanisms include PPPs with the establishment of an SPV, among other options.

Project timing: 2015–2018.

Key stakeholders:

The NEWLIGHT project is implemented by REGEA with support from the ELENA facility. ELENA was established by the European Commission (EC) and EIB with funding from the EC Horizon 2020 Programme to mobilise investments for sustainable energy projects at the local level. ELENA enhances the capacity of local, regional, and national authorities to develop investment programmes and implement economically feasible energy-efficiency projects by financing the preparation of these projects and programmes for investment and implementation.[13]

REGEA seeks to facilitate regional sustainablity through the use of renewable energy and implementation of energy-efficiency projects in 57 cities and municipalities located in Zagreb and Krapina-Zagorje counties. After performing energy audits and assessing the status quo, REGEA collaborates with each individual city and municipality to prepare an action plan for modernising, reconstructing, and managing public lighting system; evaluating potential funding sources; and identifying optimal financing models.

Project scope:

The project objective is to modernise street lighting in 57 cities and municipalities in Krapina-Zagorje and Zagreb counties. The scope of the project is to replace at least 50% of all 70,000 existing luminaires to cut at least 60% of the initial electric energy consumption (Miletić email com.).

Financing structure:

ELENA signed a contract with REGEA to provide technical assistance to support municipalities in the implementation of street lighting retrofits under the NEWLIGHT project. The total value of the contract is €790,000, of which 90% (€711,000) was provided by the EIB through ELENA and 10% (€79,000) by Zagreb and Krapina-Zagorje counties (Miletić email com., REGEA n.d.).

In addition, a trilateral agreement between REGEA and Krapina-Zagorje and Zagreb counties defined the terms of work for the NEWLIGHT project. Upgrading street lighting infrastructure required a total investment volume of €20m (EIB 2015b). REGEA established a public lighting baseline and identified available financial models, taking into account each municipality's financial situation. Based on the results of this analysis, it recommended one of three financing models (Miletić email com.):

[13] For further information on ELENA, please see deliverable D.T2.3.2 of the Dynamic Light project on the analysis of funding sources for street lighting. Novikova, A., Stamo, I., Stelmakh, K., and Hessling, M. 2017. *Guideline on finding a suitable financing model for public lighting investment: Deliverable D.T2.3.2 Analysis of funding sources*. Report of the EU funded project "INTERREG Central Europe CE452 Dynamic Light", July 2017.

1. through a tender process, a local authority awards a Design and Build (D&B) contract to a contractor for the installation of solutions described (capex paying[14] from its own budget or by debt financing);
2. a local authority contract an ESCO, applying an EPC model that specifies guaranteed savings and allocates the technical and financial risks to the ESCO;
3. a local authority establishes a PPP, applying an EPC model that specifies guaranteed savings, establishes an SPV, and exposes it to most risks.

Specific terms of the EPC and PPP agreements are developed in accordance with the Energy Efficiency and Public Private Partnership Contract Model provided by REGEA in the context of the NEWLIGHT project. Under this model, the contract expires after the investment costs are repaid, typically within a period of ten years.

To support the operation of the ESCO market and thus the realisation of these projects, REGEA uses three types of financial instruments. First, REGEA cooperates with the Croatian Bank for Reconstruction and Development [Hrvatska banka za obnovu i razvitak (HBOR)] and commercial banks to provide concessional and market loans to ESCOs. Second, with a guarantee fund managed by the Croatian Agency for SMEs, Innovation and Investments [Hrvatska agencija za malo gospodarstvo, inovacije i investicije (HAMAG/BICRO)], it seeks to facilitate and ensure loans to ESCOs and to compensate ESCOs for fees owed by municipalities. Third, it established a regional equity fund as an additional source of finance for ESCOs (Miletić email com.).

Project outcomes:

The project has saved up to 60% of baseline energy consumption for municipal street lighting, an approximate reduction of 9.5GWh and 2,800tCO_2 that saves roughly €1.8m/yr. (Zagreb County 2015).

[14] Capital Expenditure (CapEx) is money used to acquire new capital assets or maintain an existing asset in its present use (e.g., repair and maintenance). As fixed costs, CapEx is spread over the assumed lifespan of the asset; if spent to maintain the current state of use, it can be deducted in full in the current year.

7. Financing by utilities

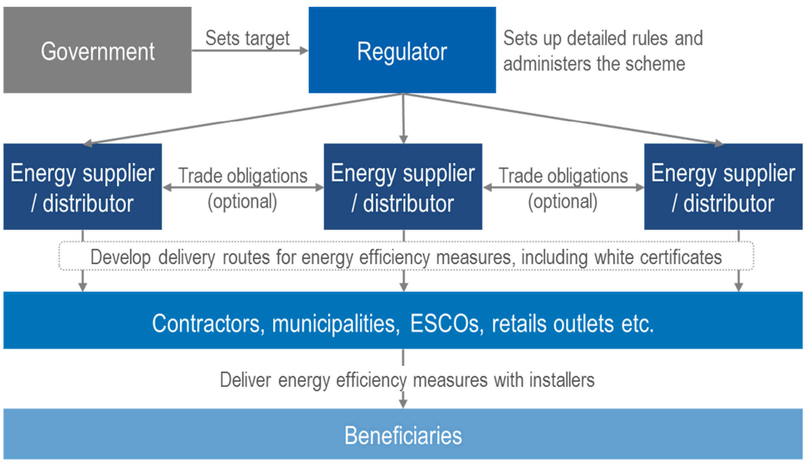
7.1. Energy efficiency obligation schemes

Model overview:

EEOSs are legally enforceable policy mechanisms that require entities included in the scheme to meet certain energy savings targets through investments in eligible end-use energy-efficiency measures. Among other key functions, EEOSs 1) set energy savings targets; 2) identify entities obligated to meet this target; and 3) a system to administer, regulate, and verify EEO activities (RAP 2012).

Entities included in the EEOS are typically energy providers and/or distributors. Entities required to meet targets can do so by implementing their own suitable energy-saving measures; outsourcing energy-efficiency measures to contractors and service providers for implementation on their behalf; purchasing the verified energy savings of other accredited parties; or contributing to a fund that finances eligible energy-efficiency projects. Specific options vary in accordance with the EEOS design. If liable entities fail to deliver the required energy savings, they will incur financial penalties (RAP 2012). Figure 26 presents the structure and main actors within utility obligation schemes.

Figure 26: Utility obligation scheme



Source: Rosenow 2017.

The energy-efficiency measures available to liable entities also vary among EEOs. Many EEOSs provide obligated parties with a list of preapproved energy efficiency measures with an energy savings value assigned to each measure. EEOSs may also specify a procedure for approving additional energy-efficiency measures that are not on the list and a methodology for calculating energy savings values for more complex projects. To cover the investment costs required to meet the energy-saving obligations, covered entities can charge end-users fees on a pass-through basis or obtain any governmental support available under the EEOS (RAP 2012).

EEOSs allow obligated parties and other eligible entities to trade energy savings certificates. An energy efficiency certificate (or white certificate) is a legal instrument issued by an authority to verify that a certain amount of energy has been saved. Obligated entities can also meet their targets through trade, either by buying additional energy savings or selling the energy savings certificates that they do not need. Trading can take place through a dedicated trading platform or bilateral agreement(RAP 2012). Among the EU member states, only Italy's EEOS has tradable white certificates (European Commission 2016c).

Projects that can be financed by this model:

Financing energy efficiency upgrades of street lighting is possible in countries that have implemented EEOS.

Advantages:

In order to achieve the targets, utilities collect dedicated funds, either as a special charge or as part of the cost of doing business (Rosenow and Bayer 2016). These funds are further used to implement energy efficiency measures. For instance, utilities may design and adopt utility programs that provide financing incentives to end-users, including municipalities. In the latter case, municipalities will not bear or will bear only partially upfront investment costs of energy efficiency projects directly benefiting from the pressure created by a EEOS on utilities to meet targets through financial penalties.

Disadvantages:

The implementation of EEOS requires having a strong regulatory framework and strong governance that it outside of the competence of local governments.

Jurisdictions that have applied the model

Energy Efficiency Obligation Schemes (EEOS) are operational in 11 EU member states—Denmark, the UK, Ireland, France, Spain, Italy, Latvia, Poland, Bulgaria, Austria, and Slovenia. Article 7 of the Energy Efficiency Directive (EED) recommended the use of EEOS as a policy measure to distribute energy savings among end-use energy consumers. In Europe, EEOSs have delivered significant energy savings and are responsible for a large proportion of Europe's energy-efficiency improvements (European Commission 2016c).

Case study: white certificate scheme, Italy

Background:

The Italian white certificate scheme began in 2004. The purpose of the scheme is to meet the requirements of the EED (as transposed into national legislation) to promote energy efficiency and strengthen the ESCO market. The scheme sets an annual national primary energy saving target and requires electricity and gas distributors with more than 50,000 customers to meet these targets through energy-efficiency measures.

Project timeframe: 2004 – present.

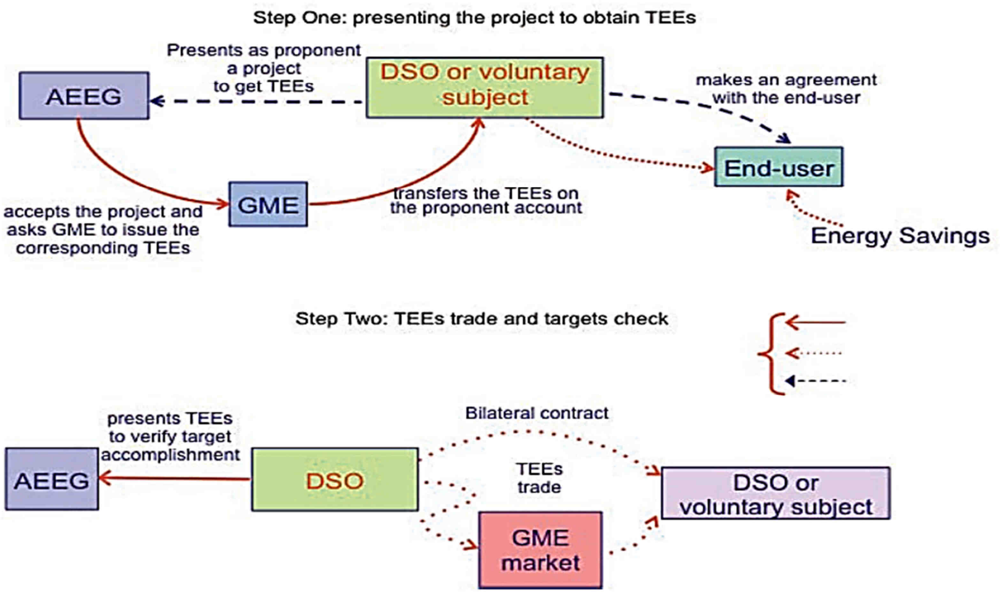
Project scope:

Eligible energy-efficiency measures include those in virtually all end-use sectors, except for efficiency improvements in electricity generation. For each eligible measures that an entity implements, the party obtains a white certificate valid for five years (eight years for measures related to building envelopes) (Di Santo et al. 2014). Analytical projects and monitoring plan projects are also eligible for white certificates (ATEE 2015). Implementation costs for measures initiated by obligated entities are passed through to the customers in their electricity and gas bills (GSE 2015).

Key stakeholders:

Annual primary energy savings targets are set by the Ministries of the Economy and the Environment. The Energy Service System Operator [Gestore Servici Energetici (GSE)] is responsible for administering the scheme and monitoring and verifying energy savings, with technical support from the Italian National Agency for New Technologies, Energy and Sustainable Economic Development [Agenzia nazionale per le nuove tecnologie, l'energia e lo sviluppo economico sostenibile (ENEA)] and other public bodies. Penalties are set by the Italian Regulatory Authority for Electricity Gas and Water (AEEGSI). The scheme includes 61 entities: 13 electrical distributors and 48 natural gas distributors. Obligated entities can implement energy-efficiency measures themselves, outsource implementation to third parties through bilateral contracts, or purchase verified energy savings through a trading platform (ATEE 2015). Figure 27 illustrates the interactions between main stakeholders in the Italian white certificate scheme.

Figure 27: Italian white certificate scheme



Source: Di Santo et al. 2011.

Notes: TEE - energy efficiency certificates (“white” certificates), GME – a electricity market operator, AEGG - Italian Regulatory Authority for Electricity and Gas, DSO – a distribution system operators.

For each verified tonne of energy (tonne of oil equivalent) saved through the energy-efficiency measures, entities receive a white certificate. Electricity and gas distributors that are not obligated to meet the targets can still implement energy-efficiency measures and obtain white certificates. Certificates are available to third parties, such as non-obligated distributors, ESCOs, companies or organisations with an energy manager or ISO-certified energy management system in place. After achieving and verifying a certain amount of energy savings, they can sell their white certificates to parties that need the certificates to meet their obligations under the scheme (GSE 2015).

Project outcomes:

Most (96%) of the white certificates are generated by non-obligated parties and then traded. As of 2015, 48m white certificates had been traded, mainly (65%) through bilateral agreements (GSE 2015). The scheme boosted the ESCO market in Italy. ESCOs account for 78% of the entities participating in the scheme (GSE 2015). The vast majority (72%) of total white certificates were issued to ESCOs (ATEE 2015), while obligated distributors earned less than 5% (GSE 2015).

In 2015, most of the white certificates (64%) were issued for energy-efficiency measures in the industrial sector due to the link between the white certificate scheme and the energy manager obligation, which primarily affected the industry sector. Only 4% of energy-efficiency improvements were related to lighting, and the remaining 32% were in the civil sector (GSE 2015).

7.2. On-bill financing

Model overview:

On-bill financing is a form of utility financing, in which a utility lends a municipality the upfront investment and the municipality repays the cost through its energy bills. Because the utility provides the initial funding, it can require and monitor the use of specific technology for the upgrades.

Projects that can be financed with this model:

The model is suitable for small- to medium- size projects.

Advantages:

On-bill financing exposes both the utility and the municipality to relatively low risks, provided that the municipally pays its energy bills. The implementation arrangements are also relatively simple (Smart Cities Council 2015).

Disadvantages:

Municipalities may encounter challenges arising from a lack of experience because the model is rarely implemented in Europe.

Jurisdictions that have applied the model

On-bill financing is more common in the United States than in Europe. In the U.S., on-bill financing programmes primarily target energy-efficiency improvements by homeowners and businesses, but municipalities can also use them for street lighting upgrades. On-bill financing is used most actively by California utilities, including Pacific Gas and Electric (PG&E) and Southern California Edison (SCE) (U.S. Department of Energy 2016). Similar programmes have also been implemented by other utilities, such as San Diego Gas & Electric.

Case study: California, the United States of America

Pacific Gas and Electric (PG&E), which operates in Northern California, provides on-bill financing for street lighting projects. PG&E provides zero-interest loans of $5,000–250,000 to public institutions for improvements in energy-efficiency technology, including LED street lighting projects, with a payback period of up to 10 years. Loan repayment is based on the projected energy savings and is included in monthly utility bills. To qualify for the on-bill financing programme, the estimated energy savings must be sufficient to repay the loan during the payback period (Pacific Gas and Electric Company 2017). As of 2016, the PG&E on-bill financing programme had funded several hundred projects that upgraded approximately 180,000 municipally-owned lights (U.S. Department of Energy 2016).

Southern California Edison (SCE), an electricity supply company for Southern and Central California, has similar conditions for on-bill financing to municipalities that perform energy-efficiency improvements, including LED retrofits of municipally-owned street lights. The loans of $5,000–250,000 are granted with a payback period of up to 10 years. The monthly repayment amount is equal to the estimated monthly reduction in the utility bill resulting from the project (Southern California Edison 2017).

8. Financing by citizens: crowdfunding

Model overview:

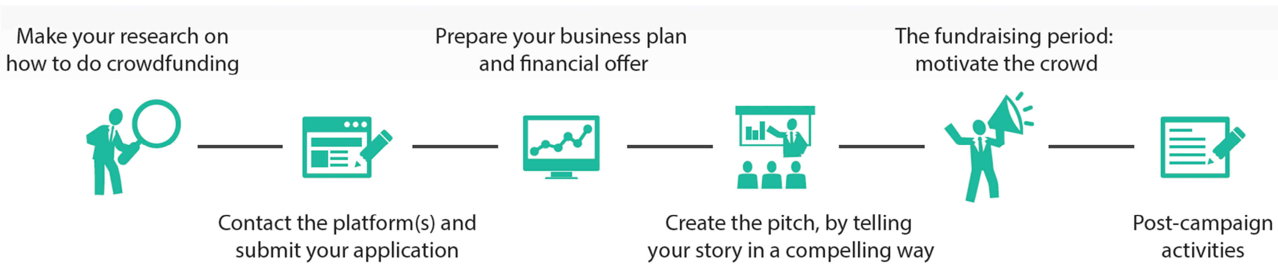
Crowdfunding is the use of relatively small amounts of money from a large number of people or investors to finance a project. Fundraisers and investors meet through online crowdfunding platforms, where fundraisers solicit contributions to finance a proposed project and interested parties pledge funds. Crowdfunding is a relatively new financing mechanism and is most often used by young, innovative companies and startups. Because the financing volume of crowdfunding has grown steeply over the last four years, use of this mechanism for community and city projects has become more common (European Commission 2016b).

There are several crowdfunding models, which vary in the relationship between the fundraiser and the project backers (crowd-investors):

- Investment-based crowdfunding: a fundraising company issues equity or debt through a crowdfunding platform;
- Lending-based crowdfunding or peer-to-peer lending: funds are obtained from crowd-investors in the form of loan agreement through an online platform;
- Invoice trading: funds are raised through the sale of unpaid invoices or receivables to a pool of investors through an online auction;
- Reward-based crowdfunding: in return for funds pledged by individuals and/or businesses, a certain reward is provided in the form of goods or services;
- Donation-based crowdfunding: individuals donate to a specific project without financial or other material returns;
- Hybrid models combine multiple approaches described above (European Commission 2016b).

Figure 28 illustrates the main steps involved in fundraising through crowdfunding platforms.

Figure 28: Main steps in the crowdfunding process



Source: European Commission 2016a

Projects that can be financed with this model:

Crowdfunding is able to finance small to medium-sized projects.

Advantages:

While the prospect of financial returns provides some motivation, in most cases people contribute to a specific campaign because of their interest in the project. Crowdfunding creates a community around the project; as a result, people can become engaged in the process and provide insights and ideas that are useful for project development. The project may attract more investors if a portion of the required finances have been raised through crowdfunding.

Disadvantages:

As with any business model, crowdfunding has risks. For example, there is no guarantee of sufficient funding; problems with the crowdfunding platform may arise; investors may be inexperienced or wish to exit; the process is not regulated; and it may be challenging to fulfil commitments to a multitude of small investors. From the investor's point of view, the risks include the loss of a portion of the capital or failure to obtain the expected returns; the lack of a secondary market; insolvency of the platform operators; and misinformation or insufficient information to price the invested securities correctly (European Commission 2016b).

Jurisdictions that have applied the model

Crowdfunding has grown increasingly popular in the past four years, especially in the UK, France and Germany. In 2015, €4.2 billion was raised through crowdfunding in the EU (European Commission 2016b). The majority of crowdfunded projects implemented models with financial returns, such as lending- or investment-based crowdfunding or invoice trading (ibid.). The main trends in crowdfunding development include the consolidation and internationalisation of crowdfunding platforms, as well as co-investment from a growing number of institutional investors (e.g., venture capital and angel investors) alongside individuals (ibid.).

Case study: bettervest crowdfunding platform

Background:

Bettervest (stylised as 'bettervest') is a Germany-based crowdfunding platform for climate-change mitigation projects. As of 2017, it had helped fundraise for roughly 50 energy-efficiency projects of various sizes and scopes in Germany and other countries. Project funding can range from €4,000–€600,000 and has shown a progressive increase. The platform has reported that all Bettervest-supported projects have reached their respective funding targets (Bettervest 2017a).[15]

Project scope:

Some Bettervest projects support lighting upgrades. For example, one project solicited funds to upgrade lighting in a public school in Szeged, Hungary. The school, which had an enrolment of 1,150 students, stood to benefit from significant energy savings if conventional lighting technologies were replaced with LEDs.

Key stakeholders:

Through Bettervest, the school raised €46,400 from 92 investors.

Financing structure:

After securing funds, the school signed a 10-year lease-purchase contract with LED-LIGHT-Germany. Under the agreement, the school pays LED-LIGHT-Germany €6,542 per year for upgrades and installation work. The contract also transfers the obligations towards crowd-investors from the school to LED-LIGHT-

[15] For a list of current and completed projects, please visit the platform website at https://www.bettervest.com.

Germany. LED-LIGHT-Germany will have seven years to pay back 100% of the funds borrowed from the crowd-investors and must also pay them a 7% rate of return.

Project implementation and outcomes:

The project is expected to provide energy savings of more than 70% and significantly reduce the school's energy and maintenance costs (Bettervest 2017b).

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Annex I. Methodology

We employed several data collection methods. Above all, we gathered information available in the public domain. In particular, we identified and reviewed documentation of projects that had already conducted similar studies in the past. We also gathered other available information, including from reports, articles, interviews, and Internet websites. Finally, we drew on the extensive experience of SWARCO, as the manager of street lighting infrastructure in a large number of cities in various contexts and with various models. From our review, we concluded that, to date, there has been no comprehensive catalogue of business models and best practices for energy-efficient street lighting in Europe. Therefore, we identified individual case studies from additional surveys and personal interviews.

We surveyed the project target group using two questionnaires. First, we conducted a detailed survey of project partners using an online questionnaire. After analysing the results of this internal survey, we refined the questionnaire and sent it out to the expert community and stakeholders outside of our consortium with an interest in street lighting. To do so, we identified the contacts of 34 associations of municipalities, cities, towns, and countries in Central Europe and asked them to forward our survey to their members. We also identified the contacts of approximately 200 key stakeholders from the priority group for our task and sent them invitations to complete the survey. Recipients included representatives from regional or national energy agencies, utilities, product manufacturers, engineering service providers, energy service companies, and researchers. Finally, we sent out the survey though the mailing list Climate-L.[16]

Our survey was answered by 59 respondents. Of these, 55 were from the EU countries. These were the representatives of 15 municipalities; two associations of municipalities, including the Association of Cities of the Republic of Croatia and the Association of Polish Cities; four regional energy and development agencies, including the North-West Croatia Regional Energy Agency, the Energy Agency for Southeast Sweden, the APE FVG Energy Management Agency of Friuli Venezia Giulia, and AGIRE Energy Agency of the Province of Mantova, Italy; five lighting product manufacturers; three energy service contractors and/or energy service companies and/or their associations; 21 research organisations or consultancies; and six consumers. For further details, please see our Deliverable D.T2.3.1. Baseline inventory.[17]

Each business model was analysed within a common framework. First, we developed a model overview based on its schematic structure, e.g., its key actors and their roles. Second, we analysed the types of projects that could be financed using these models. Third, we argued about the advantages and disadvantages of the models. Finally, for each business model, we selected a case study, in the context of which we developed greater details on the model, scope, stakeholders, implementation experience, and outcomes.

Above all, we focussed on financing models and relevant case studies in Central Europe. However, when a useful model was available only outside Central Europe, we included it, with priority given to models in the EU, then Europe, and finally worldwide.

To validate our results, we contacted organisations involved in the implementation of case studies. These included municipalities, their companies, and financial intermediaries. These organisations and individuals are listed in the Acknowledgments section.

[16] Please see http://sdg.iisd.org/sdg-update/about-the-sdg-update-newsletter/ for information on Climate-L.

[17] Novikova, A., Stamo, I., Stelmakh, K., and Hessling, M. 2017. Guideline on finding a suitable financing model for public lighting investment: Deliverable D.T2.3.1 Baseline inventory. Berlin: University of Greifswald, IKEM, SWARCO.

Annex II. Guides for individual financing models

The following table presents a list of guides available for individual financing models. The full reference list is provided below the table.

GUIDE AUTHOR(S) AND YEAR	SELF-FINANCING		DEBT		THIRD PARTY				UTILITIES		CROWDFUNDING
	REVOLVING FUND	INTRACTING	LOANS	BONDS	PPP	EPC	LEASING	PROJECT FINANCE	OBLIGATION SCHEME	ON-BILL	
Climate Bonds Initiative. 2017.				X							
Clinton Climate Initiative. 2009.						X					
EC. 2016.											X
EnergyCities. 2016		X									
ESMAP. 2014.	X										
German Watch. 2015.		X		X		X					X
Limaye et al. WBG 2014	X										
RAP. 2012.									X		
Rosenow, Jan. 2017.									X		
Schaefer et al. Infinite Solutions. 2017	X										
Scottish Futures Trust. 2013.					X	X		X			
SEAI. 2017.						X					
SEIA. 2011						X					
SEIA. 2014.						X*					
Sustainable Corporate Real Estate Roundtable. 2009						X					
The Climate Group. 2013.			X		X	X	X				
Trainrebuild. 2011.			X						X		
UK Department of Energy and Climate Change. 2015.						X					

GUIDE AUTHOR(S) AND YEAR	SELF-FINANCING		DEBT		THIRD PARTY				UTILITIES		CROWDFUNDING
	REVOLVING FUND	INTRACTING	LOANS	BONDS	PPP	EPC	LEASING	PROJECT FINANCE	OBLIGATION SCHEME	ON-BILL	
UK Department of Energy and Climate Change. 2015.			X	X	X	X					
UN-Habitat. 2009.			X		X						
Zirkwitz. 2016.		X									

*This guide addresses the Energy Performance Related Payments (EPRP) model, one of EPC variations.

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