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Financing models for energy-efficient urban street lighting

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Outline

Aim and tasks

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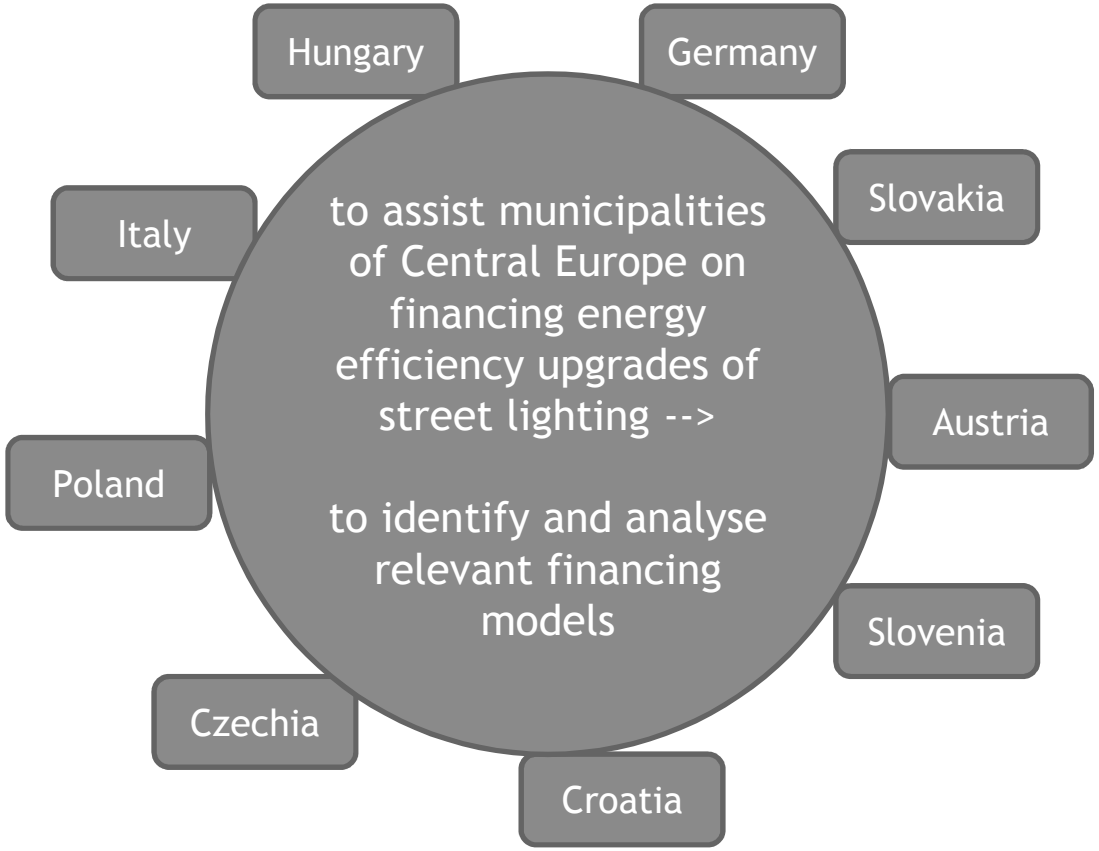
Financing models

- Self financing
- Debt financing
- Financing by private contractor
- Financing by private contractor through energy savings
- Other public-private partnerships
- Financing by utilities
- Financing by citizens

Conclusions

Aim and task


Hungary
Germany
Slovakia
Italy
to assist municipalities of Central Europe on financing energy efficiency upgrades of street lighting -->
to identify and analyse relevant financing models
Austria
Poland
Slovenia
Czechia
Croatia

Methodology

Interviews via Phone and E-Mail

- Ministries, utilities, municipalities, cities, EU funds, international financial intermediaries, etc.

Model overview structure

- Architecture
- Key actors and their roles
- Projects that could be financed
- Advantages and disadvantages

Online Survey

- Sent to 34 associations of municipalities and 300 other stakeholders.

Furthermore

- Experiences from own operations (SWARCO)
- Literature review
- Screening project websites
- Screening database

Conducting individual case studies

- For each model, a case study is available confirming the theoretical finding

Review of models identified

Self-financing
- Budget allocation
- Internal contracting
- External revolving fund

Debt-financing
- Concessional loans
- Commercial loans
- Bonds
- Institutional investors

Financing by a private contractor
- Simple contracting model
- Contracting with forfeiting and waiver of defense

Financing through energy savings (EPC)
- Guaranteed savings model
- Shared savings model
- Other energy performance contacting

Leasing or concession to a private partner
- Leasing
- Concession to a private partner

Project finance
- Special purpose vehicle (SPV)

Financing by utilities
- Energy Efficiency Obligation Schemes
- On-bill financing

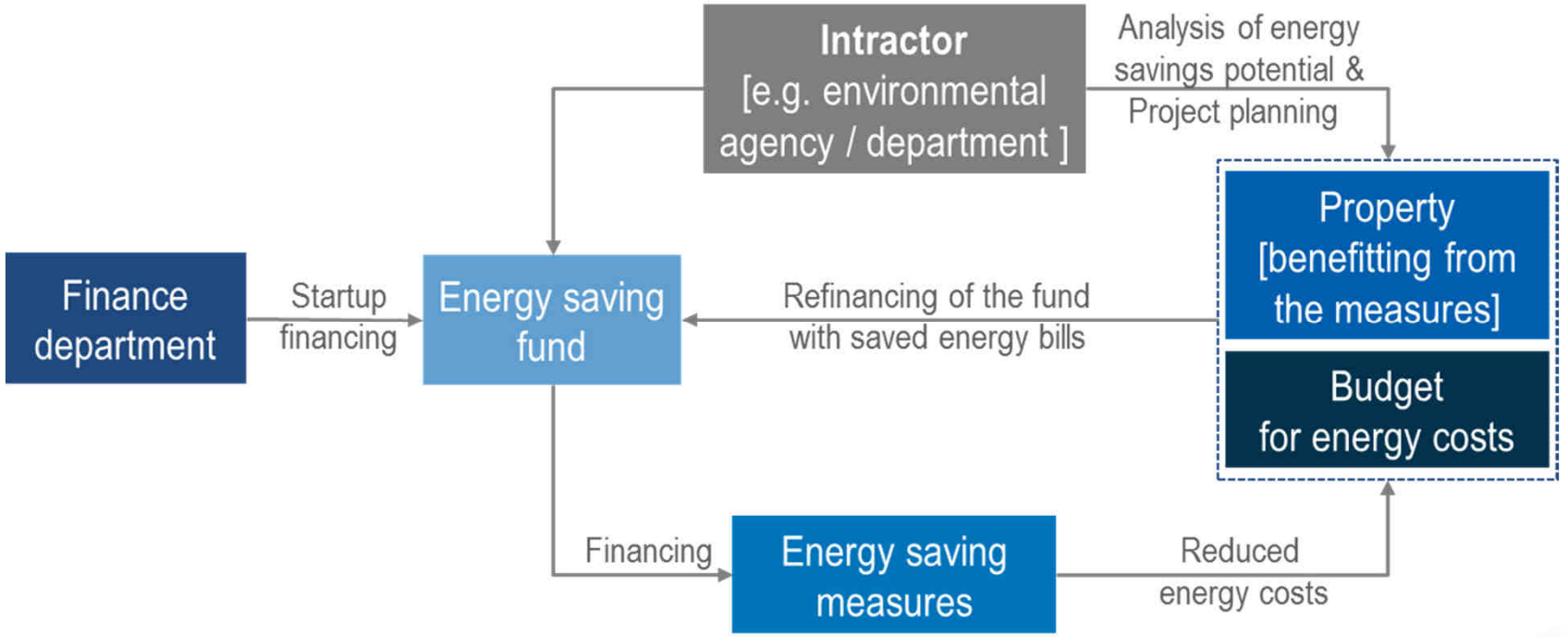
Financing by citizens
- Crowdfunding

Source: Novikova, et al . 2018. Best practice guide. Deliverable D.T2.3.3 .
URL: www.interreg-central.eu/Content.Node/Dynamic-Light.html

Self-financing

Self-financing | Model 1: Intracting

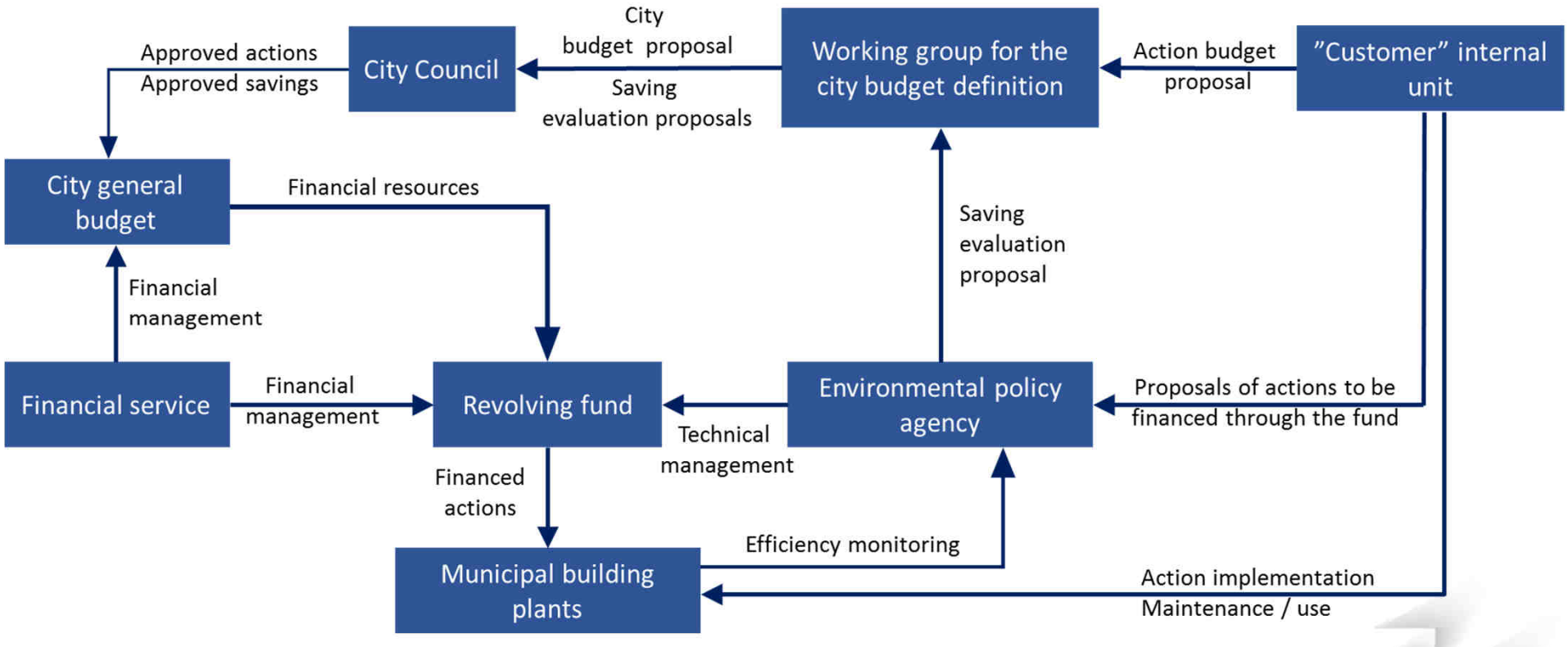
- Internal organisational units act as contracting partners
- Energy savings from funded projects are redirected to the fund



Source: Junghan and Dorsch (2015) in Novikova et al. (2018).

Intracting
Case study - Udine, IT (2015 – …)

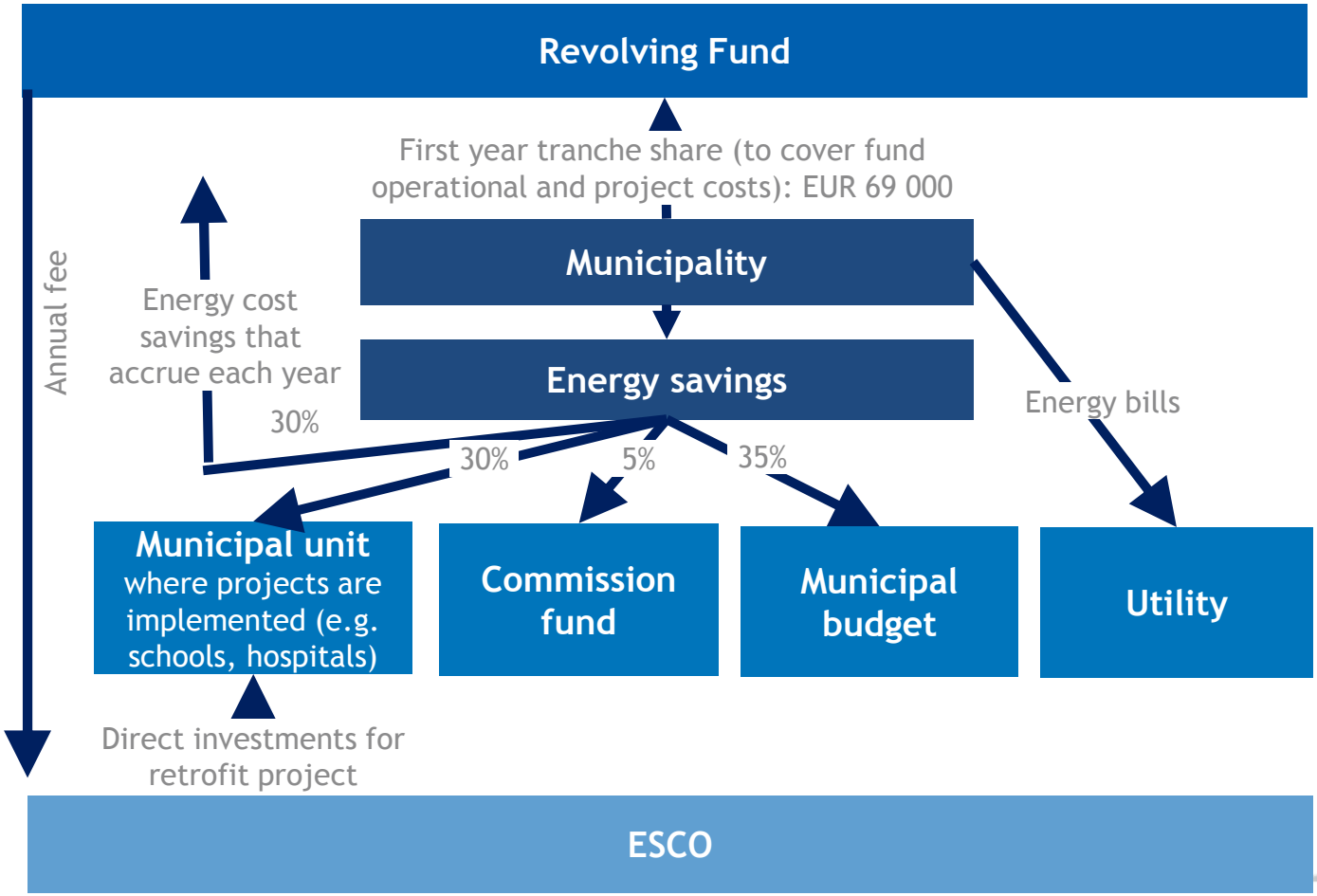
- Initial funding of 32 kEUR by the city
- The scheme relies only on contracting internal units



Source: Schaefer et al. (2017) in Novikova et al. (2018).

Intracting
Case study- Litomerice, CZ (2014 - …)

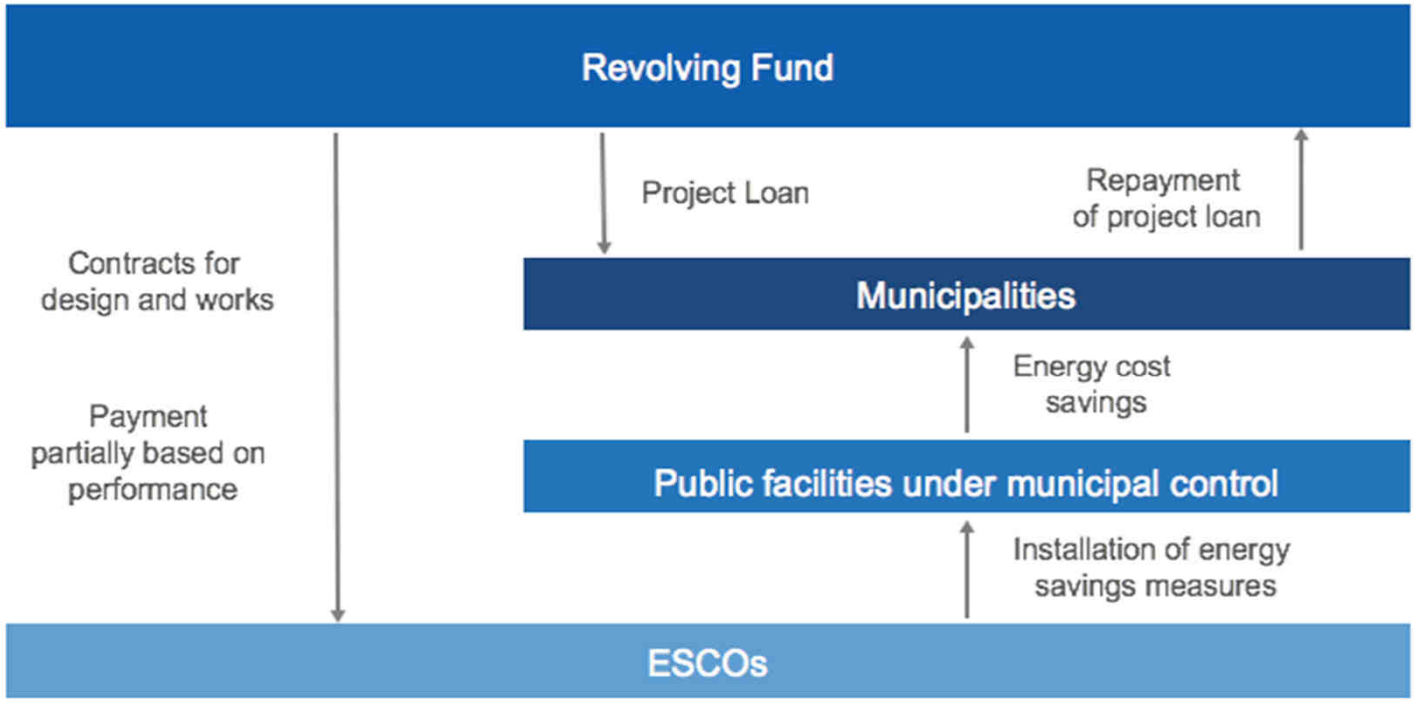
- Municipality initiated a fund, provided capital and manages the fund
- Fund provides financial instruments to external service providers



Source: Authors' own figure based on the data of the City of Litomerice in Novikova et al. (2018).

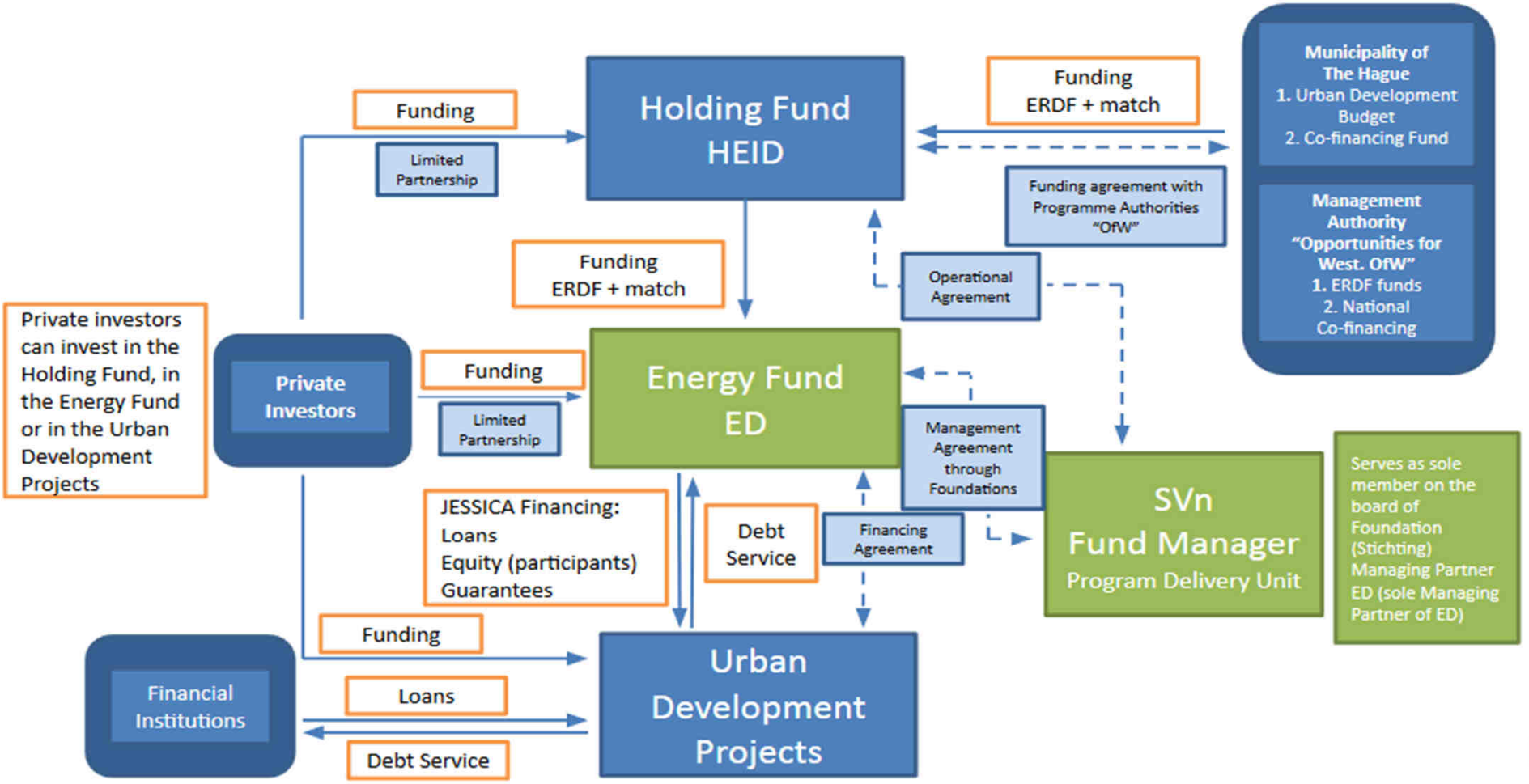
Self- financing | Model 2: External revolving fund

- Revolving fund uses external funding sources and lends to municipality units



Source: ESMAP (2014) in Novikova et al. (2018).

External revolving fund - Case study: Hague, NL (2013 - …)



Source: https://www.svn.nl

Debt-financing

Debt-financing | Model 1: Bonds

Architecture

- Municipal bonds are issued by the local government or their agencies
- Bonds can be certified as *green bonds* by an independent institution

Advantages

Municipalities:
- Can issue bonds autonomously or in cooperation with bond agency
- Get low interest rates compared to commercial bonds or loans

Other features

Projects that can be financed by this model:
- Any project, if the municipal has access to a bond agency

Jurisdictions that applied this model:
- Gothenburg (SWE) & Varna (BGR)
- Not common in Europe

Disadvantages

Municipalities:
- Need to prepare extensively and costly
- Need a good credit rating, if acting autonomously

Source: Novikova et al. (2018)

Bonds – Case study
Gothenburg's Green Bonds, SE (2013-…)

Project overview

- Gothenburg implemented its Green Bond Program in 2013
- Using it, it raises capital for climate change and environmental projects

Project scope

- Eligible projects include: mitigation, adaptation/ resilience and the environment
- Projects are selected by the city office and approved by the city executive board

Financing structure

- Bonds are issued on the capital market, any mainstream investor can buy them
- 1st bond issued accounted for 56 mEUR
- Total capital raised 0.46 bEUR in 2016

Implementation & outcome

- Gothenburg was the first city to issue green bonds
- Since 2013, 11projects have been funded

Source: Novikova et al. (2018)

Debt-financing | Model 2: Engaging institutional investors

Architecture

- Institutional Investors include insurance companies, pension, mutual funds etc.
- They focus on long-term, low risk investments

Advantages

Municipalities:

- Can get access to a vast sum of capital interested in long-term, low-risk projects
- Can in theory also finance non-climate related projects with this instrument

Projects that could be financed

- Any project that can meet the financial criteria of the investor (risk-return-ratio)

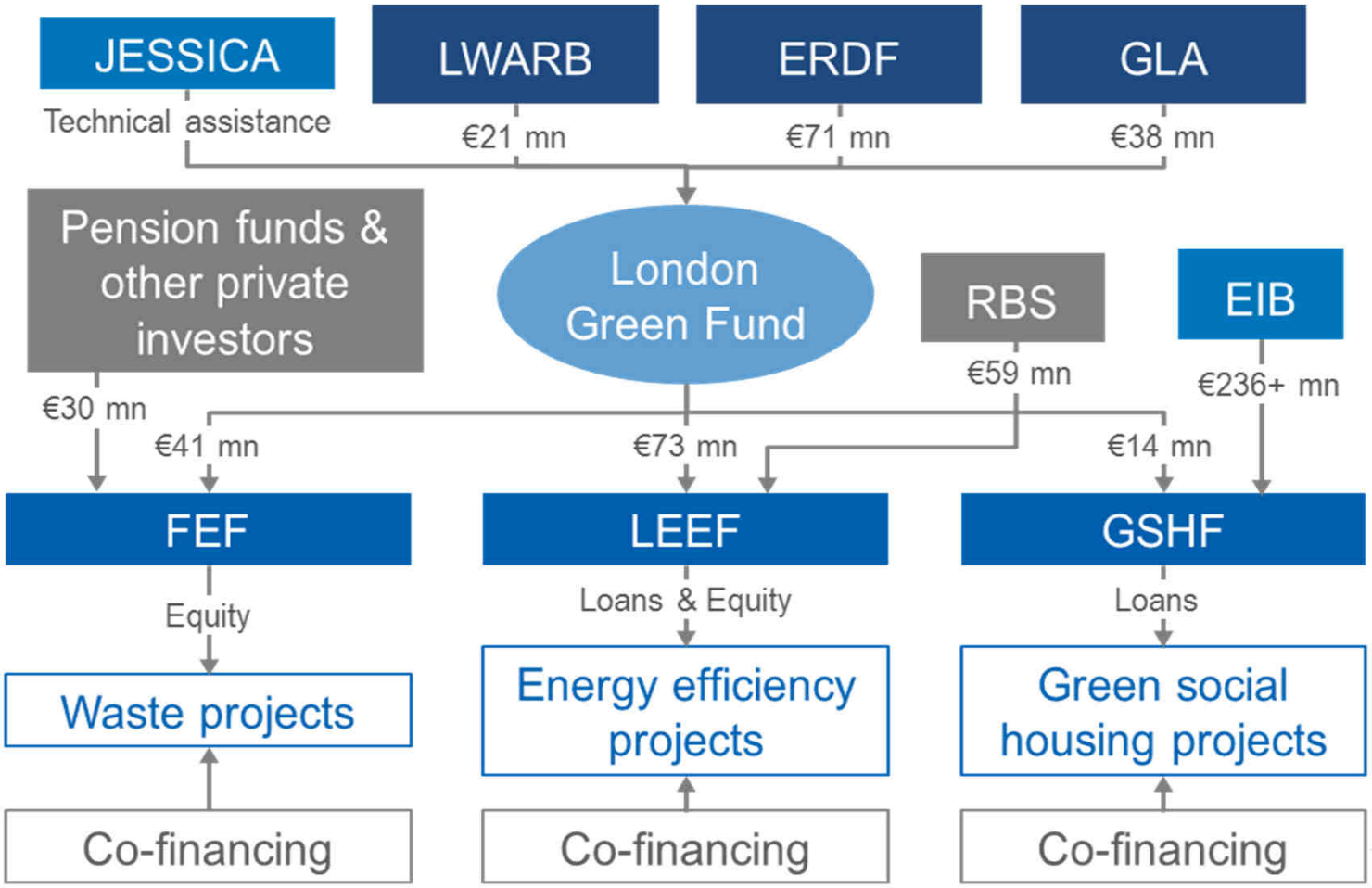
Disadvantages

Municipalities:

- Have to cope with relatively high transaction costs of the investor
- Have to bundle their small scale projects

Source: Novikova et al. (2018).

Engaging institutional investors
Case study - London Green Fund, UK (2009-...)

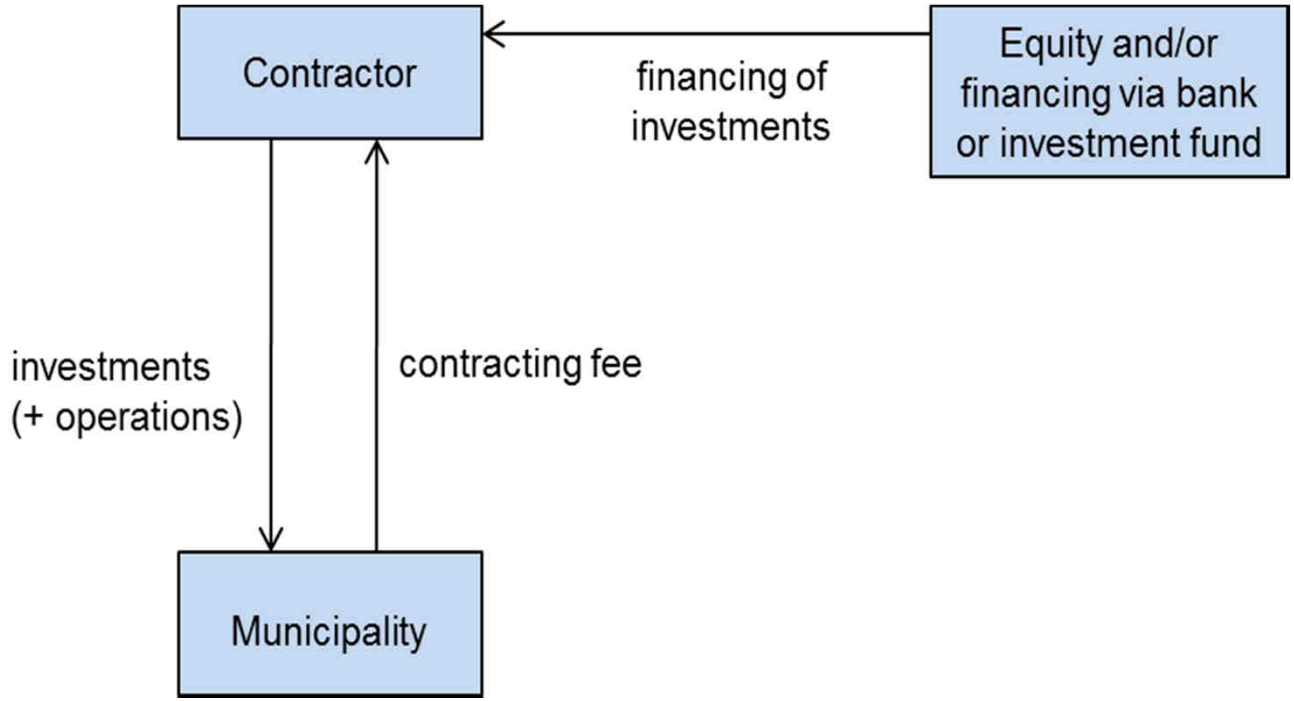


Source: EIB (2015) in Novikova et al. (2018)

Financing by a private contractor

Financing by a private contractor | Model 1: Simple contracting model

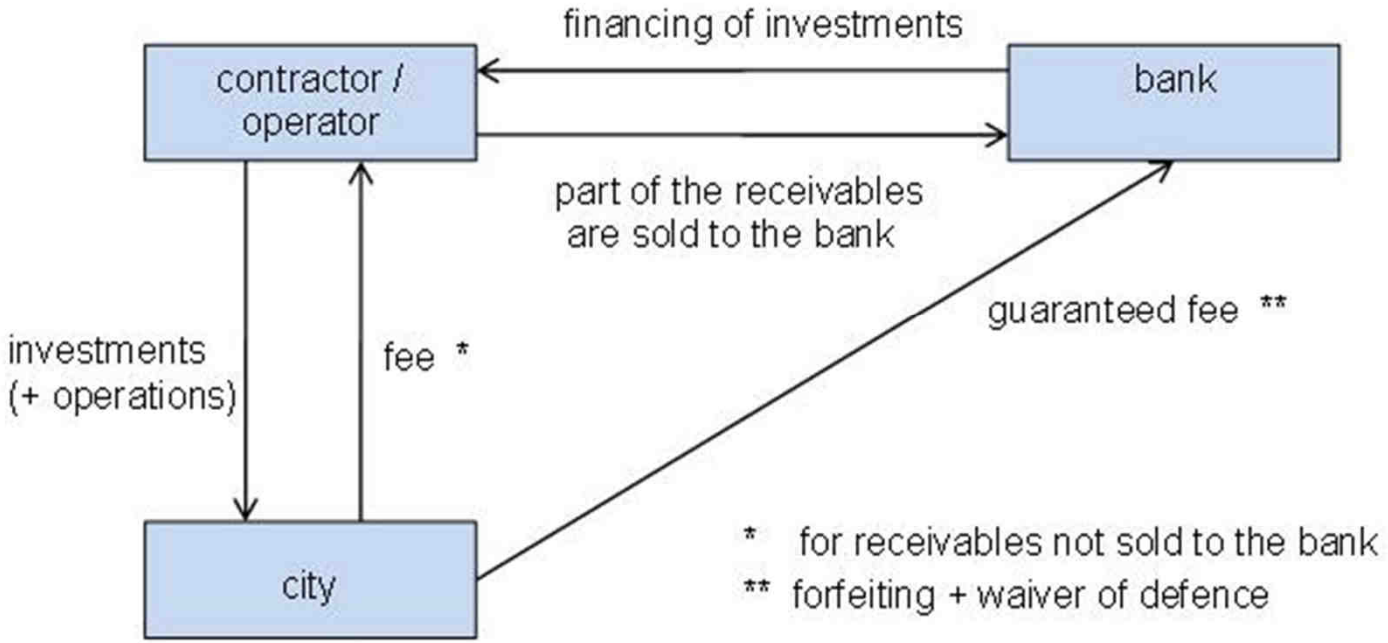
- Contractors responsibilities include planning, financing and executing investment in street-lightning
- Contracting fee covers costs for above responsibilities and include a margin



Source: Novikova et al. (2018).

Financing by a private contractor | Model 2: Contract with forfeiting & waiver of defence

- Similar to the simple model, but a bank enters agreements with both parties
- Part of the contractors fee are paid to the bank for financing equipment
- The city guarantees the margin to the bank, even if there are no savings The risk is solely with the contractor



Source: Novikova et al. (2018).

Contract with forfeiting & waiver of defence
Case study - Dillenburg, DE (2012 - …)

Project overview

- Dillenburg tendered the upgrade of its street lighting over a 12 year period
- The decision was based on cost reduction incl. contracting fee and energy costs

Project scope

- Energy efficient modernization of 2,450 luminaries

Financing structure

- 70% of the contractors receivables are paid to a bank, which received also a guarantee from the city for 12 years
- The contractor guaranteed 50% energy savings, if higher, the contractor receives a part of it

Implementation & outcome

- Replacement of the old luminaries took place in less than 3 months
- Savings are higher than guaranteed, making the project more profitable for the contractor an the municipal

Source: Novikova et al. (2018).

Contract with forfeiting & waiver of defence
Case study - Litomysl, CZ (2016 - …)

Project overview

- Given its UNESCO world heritage status, the city had to conduct modernization of street-lightning needs complying with national heritage-rules

Project scope

- Modernization of 1,225 luminaries by LEDs with dimming, traffic monitoring and remote control in real time
- All installation works had to be implemented between 2014-2015

Financing structure

- Contract period of 10 years
- 97% of receivables sold to the bank (guaranteed by the municipality)
- 26.9% of guaranteed energy savings

Implementation & outcome

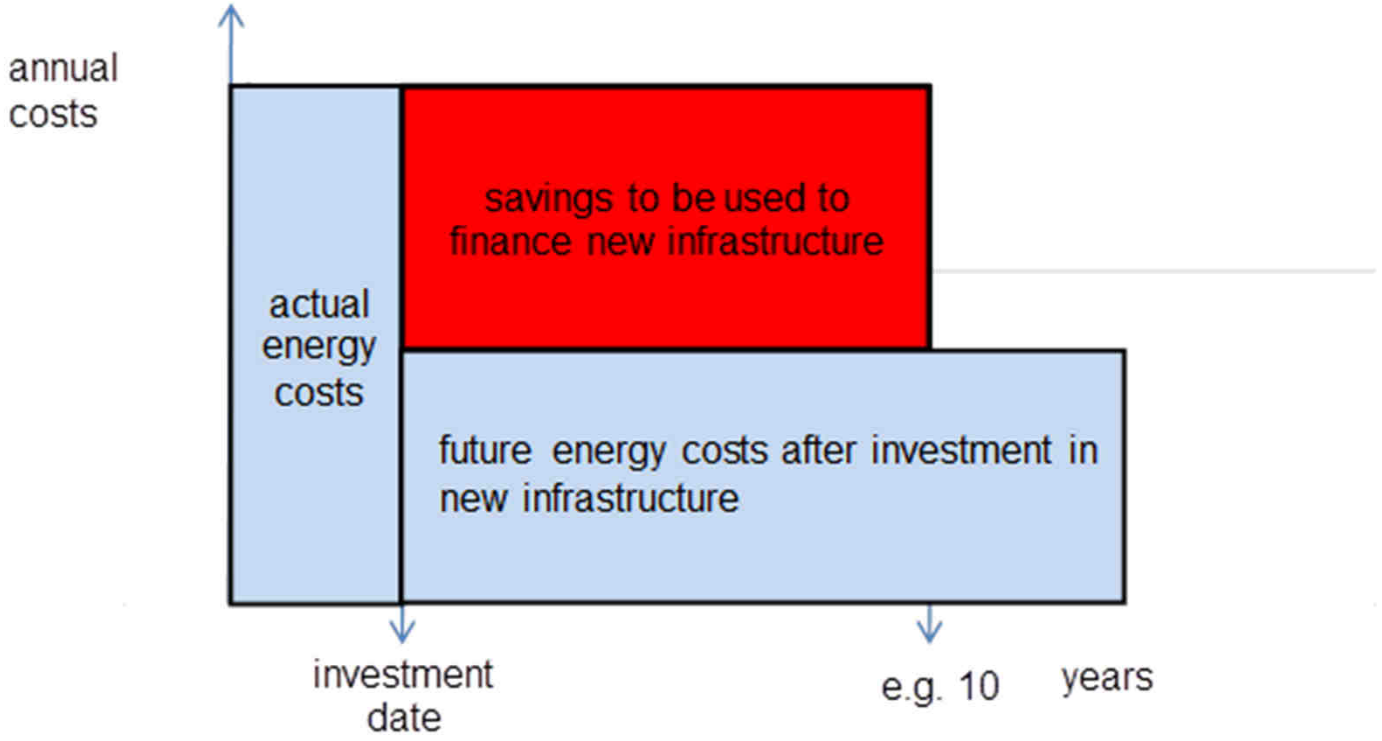
- Savings are higher than guaranteed, making the project more profitable for the contractor and the municipality

Source: Paulík (2017) and Maly (2017) in Novikova et al. (2018).

Financing by private partner through energy savings

Energy performance contracting (EPC) | Model 1 with guaranteed savings

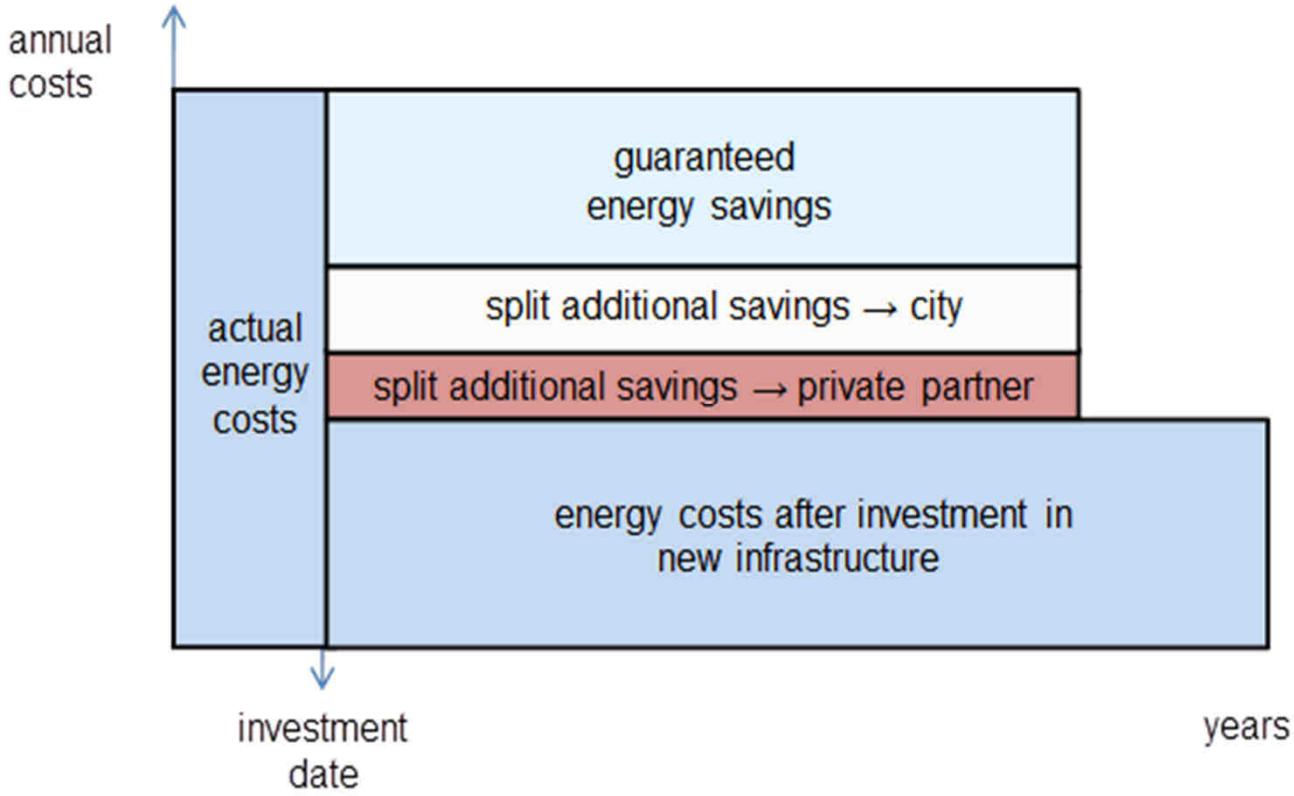
- A contractor designs and implements a project with a savings target
- If energy savings are below the target, the contractor covers the shortfall, while higher savings fully benefit the municipality
- The municipality pays a fixed fee to the contractor during the period



Source: Novikova et al. (2018)

Energy performance contracting (EPC) | Model 2 with shared savings

- A contractor designs and implements the project, with a savings target and receives a fixed premium from the municipality
- If energy savings are below the target, the contractor covers the shortfall
- Higher savings result either in a €/MWh bonus or in sharing the savings



Source: Novikova et al. (2018)

EPC with shared savings
Case study - Nauen, DE (2011 - …)

Project overview

- The city of Nauen, Germany, tendered a 5 year contract for operation of its street light infrastructure
- Targets set were a luminary replacement and energy savings of 40%

Project scope

- 2,350 luminaries should be upgraded over five years
- A savings split 50/50 between municipal and private contract partner

Financing structure

- The project enabled to invest in more infrastructure over the project period
- The payments made by the municipality were compensated by achieved energy savings

Implementation & outcome

- Savings were slightly higher than estimated in the tender
- Therefore both the contractor and the municipal benefitted slightly more than estimated

Source: Novikova et al. (2018)

Energy performance contracting | Model 3 with immediate savings

Architecture

- Immediate refers to a period as short as possible, which is suitable if all the luminaries need to be upgraded
- This enables to benefit from energy savings as soon as possible

Advantages

Municipalities:

- Can benefit from energy savings as fast as possible
- Can benefit from very low maintenance costs of technological up-to-date luminaries

Projects that could be financed

- Projects in which all luminaries need to be exchanged, capable in short-term

Disadvantages

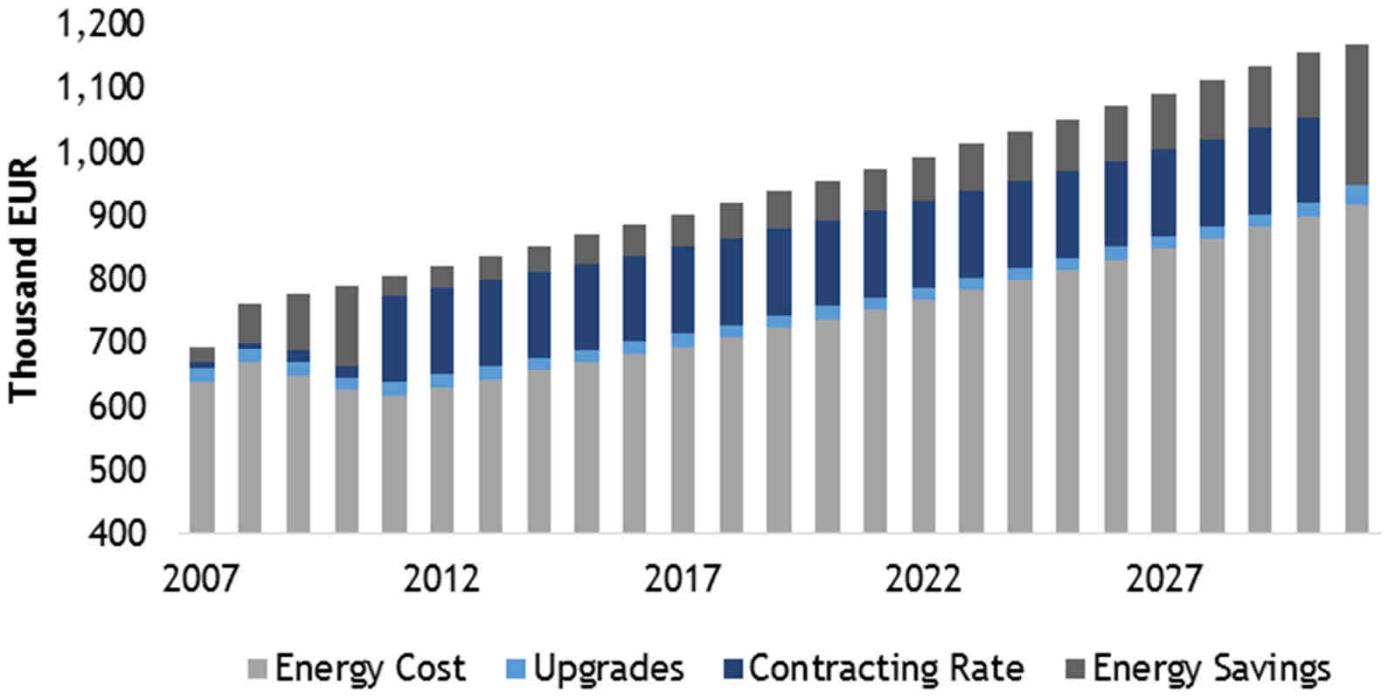
Municipalities:

- Cannot upgrade their infrastructure on a decent rate in long-term projects, leaving them with old infrastructure at contract expiration

Source: Novikova et al. (2018)

EPC with immediate savings | Case study - Graz, AT (2007 - 2010)

- 18,000 luminaries were replaced within 3 years



Source:
Energie Graz GmbH & CoKG (2010) and Grazer Energieagentur (2010) in Novikova et al. (2018).

Energy performance contracting (EPC) | Model 4 with staggered savings

Architecture

- Modernization happens over a given time frame to avoid aging infrastructure
- Starting with the oldest, luminaries are exchanged at different stages, until the total infrastructure is upgraded

Advantages

Municipalities:

- Have an efficient street lighting throughout time
- Benefit from a regular investment scheme, avoiding investment peaks
- Benefit from long-term upgrades, from worst to best luminaries over time

Projects that could be financed

- Suitable for projects with infrastructure of different age and technology

Disadvantages

Municipalities:

- Benefit from cost savings and lower installment costs only in the later stages

Source: Novikova et al. (2018)

EPC with staggered savings
Case study - Hilden (2015 - ..)

Project overview

- Hilden tendered a contract to modernize 5,000 luminaries and 2,400 poles
- Hilden set it wanted a fixed age of all luminaries at different stages (5,10,15 and 20 years)

Project scope

- The amount of luminaries account to nearly all of Hilden's street-lightning infrastructure and half of its poles
- The contract included operation and modernization

Financing structure

- Direct energy cost are covered by the contractor
- Payments are made by the city and are compensated by energy savings
- Energy savings are split 50/50 between the city and the contractor

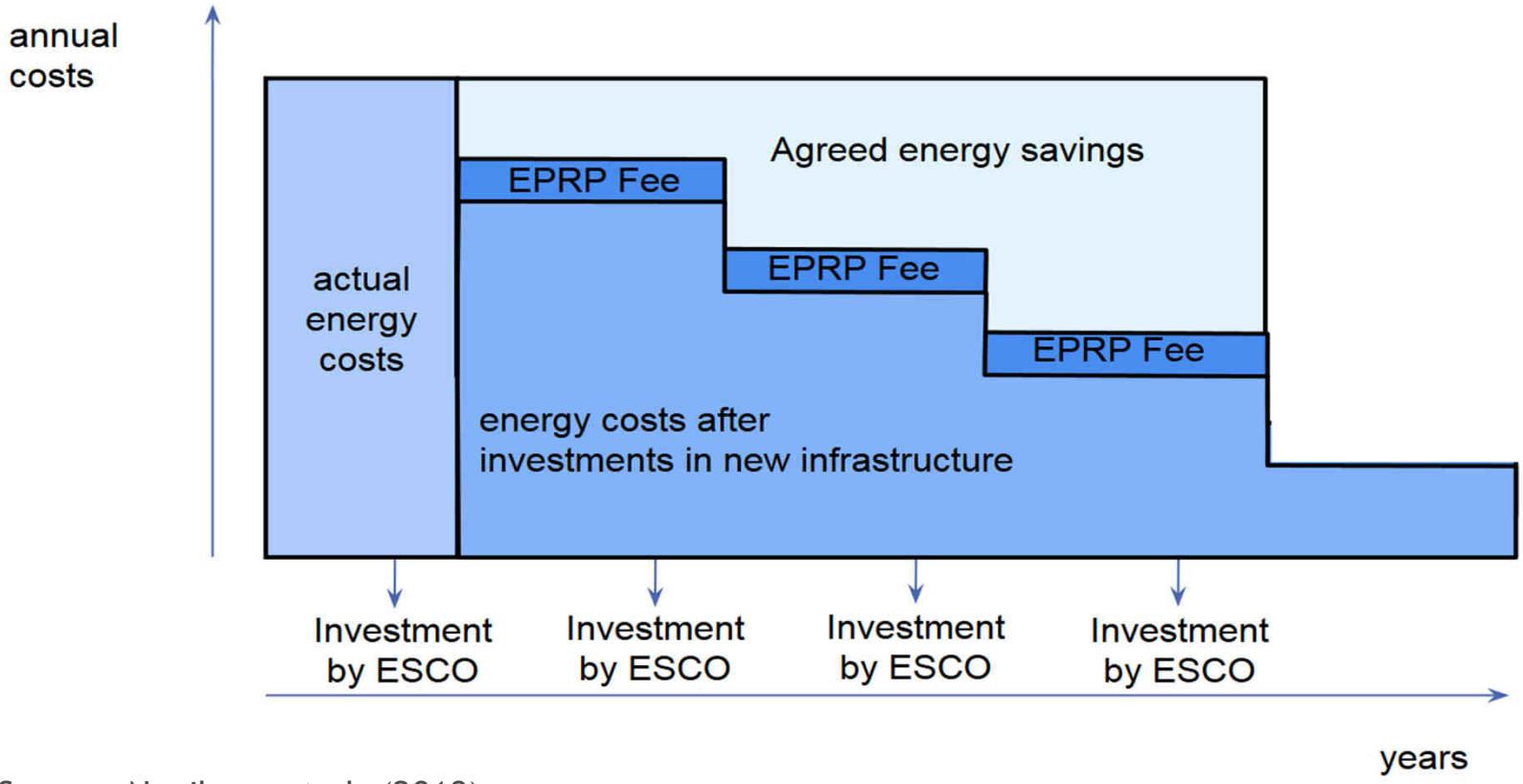
Implementation & outcome

- An optimized time schedule was implemented for the whole 20 year period

Source: Novikova et al. (2018)

Energy performance contracting (EPC) | Model 5 with related payment (EPRP)

- Fixed Payments to the contractor are a proportion of energy savings; less savings mean less premium to the contractor



Source: Novikova et al. (2018)

EPC with related payments
Case study - Kilkenny County (2017 - …)

Project overview

- The county tried to reduce energy costs by updating its street lightning infrastructure to LED

Project scope

- The project covers 1,300 of 9,800 luminaries
- The total investment was 600 kEUR covered by the Sustainable Energy Authority Ireland (30%) and the municipality (70%)

Financing structure

- The contractor issued a 225 kEUR energy performance bond; its cover equals to 50% of guaranteed energy savings over 5 years. If the target is achieved, the bond is reduced annually.

Implementation & outcome

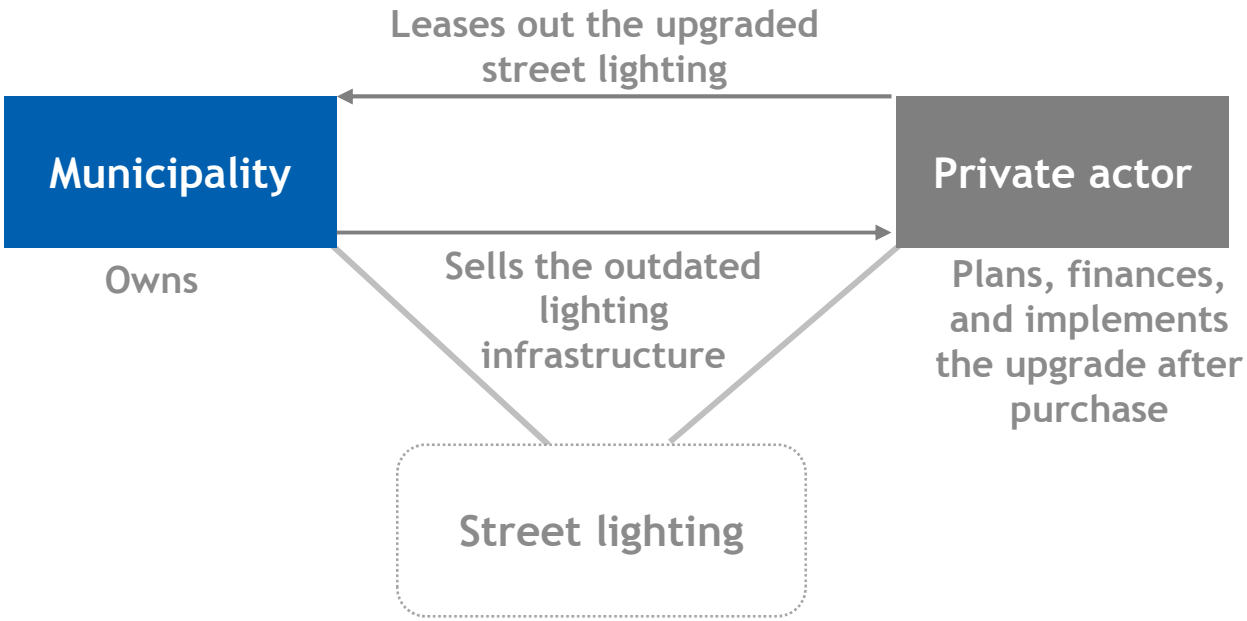
- Total energy costs and energy consumption reduced by 35%
- Annual maintenance cost decreased by 82%

Source: Keogh (2017) in Novikova et al. (2018)

Other public-private partnerships (PPPs)

PPPs| Model 1: Leasing the infrastructure

- The municipal sells the street lighting infrastructure to the contractor conditional on upgrading, operating and maintaining it
- The municipality leases it back for a fee
- At the expiring date, ownership is often transferred back to the municipality



Source: Novikova et al. (2018)

Leasing
Case study - Cesena (2015 - …)

Project overview

- Cesena aims to decrease energy consumption by 30-40% and increase effectiveness of lighting in public spaces
- All existing and new street lights shall be upgraded to LED

Project scope

- Out of 21,000 luminaries ownership of 15,830 was transferred to the contractor partner in 2010, renewed in 2015
- The contractor is responsible for maintenance, control and management of the network and upgrading it

Financing structure

- In 2010-2017, 2.3m EUR were spent to upgrade the oldest 4,880 luminaries
- The municipal pays a leasing fee to the contractor, which in turn upgrades the street-lighting infrastructure
- At expiry ownership is transferred back

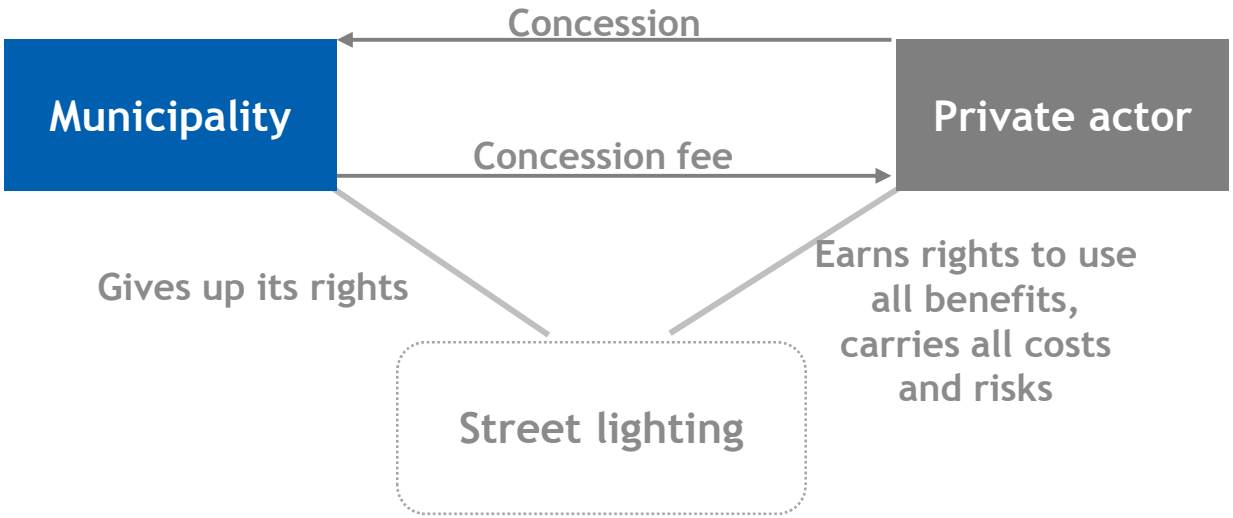
Implementation & outcome

- The municipal has created an investment plan together with the contractor
- The street-lighting infrastructure is now upgraded accordingly, but off-balance sheet for the municipal

Source: Burioli (2017) in Novikova et al. (2018)

PPPs| Model 2: Concession to a private contractor

- The municipality grants concession to operate and maintain its street-lighting infrastructure to a private partner and it pays a fee for this
- Upgrading the infrastructure will increase the benefits of the private partner by reducing costs of operation



Source: Novikova et al. (2018)

Concession
Case study - Paris (2011 - …)

Project overview

- Paris contracted a consortium of private companies for maintenance and operation of its infrastructure
- The infrastructure includes 175,000 lighting points; 30,000 lighting consoles and 63,000 street lights

Project scope

- All street and traffic lightning of the city of Paris is included
- The consortium has to assist in project management, asset management and technical support

Financing structure

- Paris tendered almost 450m EUR in concession fees and transferred operating and maintenance rights to the contractor
- The guaranteed energy savings are 42 GWh over 10 years back-up by a financial penalty in case of non compliance

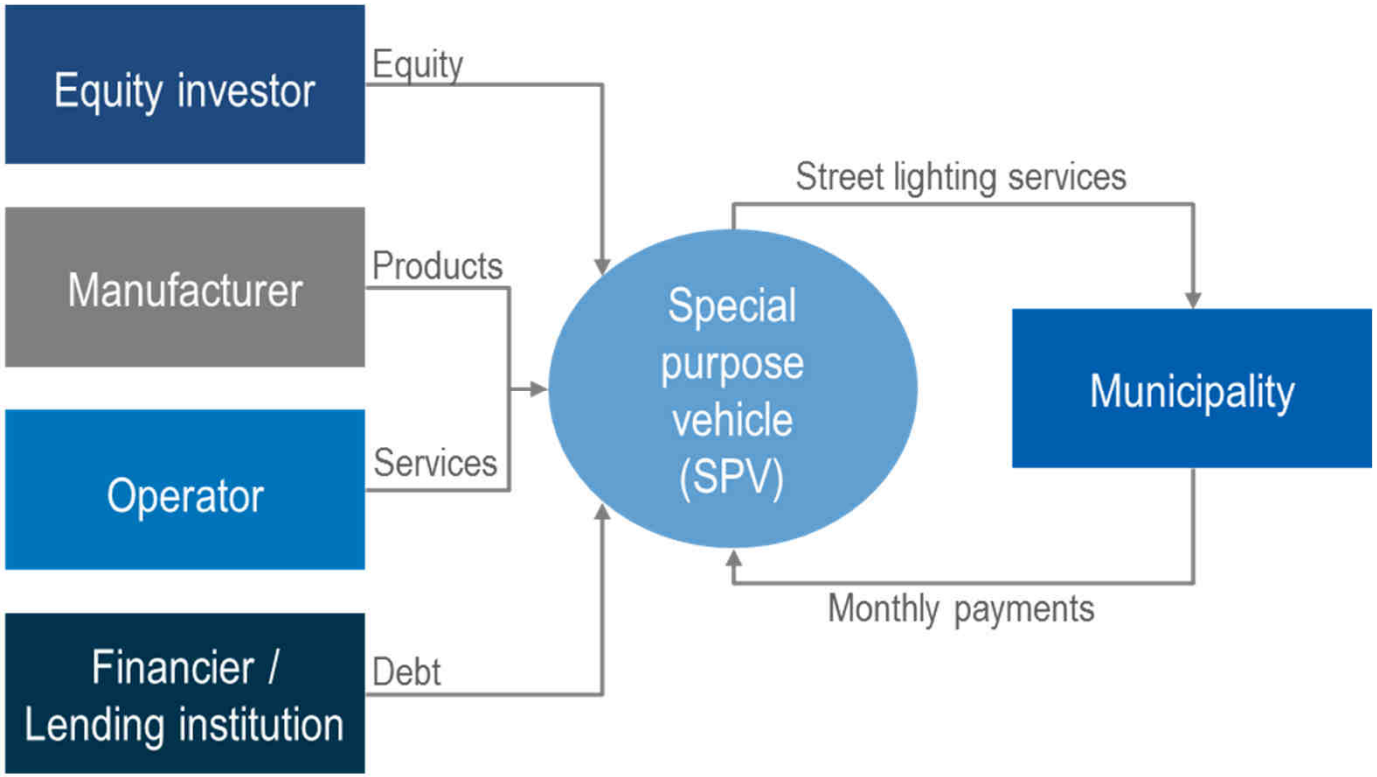
Implementation & outcome

- The consortium aims to reduce energy consumption by 30% until 2020 by upgrading a third of the lighting infrastructure, 20% of it to LEDs
- Emissions are already reduced by 24%

Source: Duguet (2017) Novikova et al. (2018)

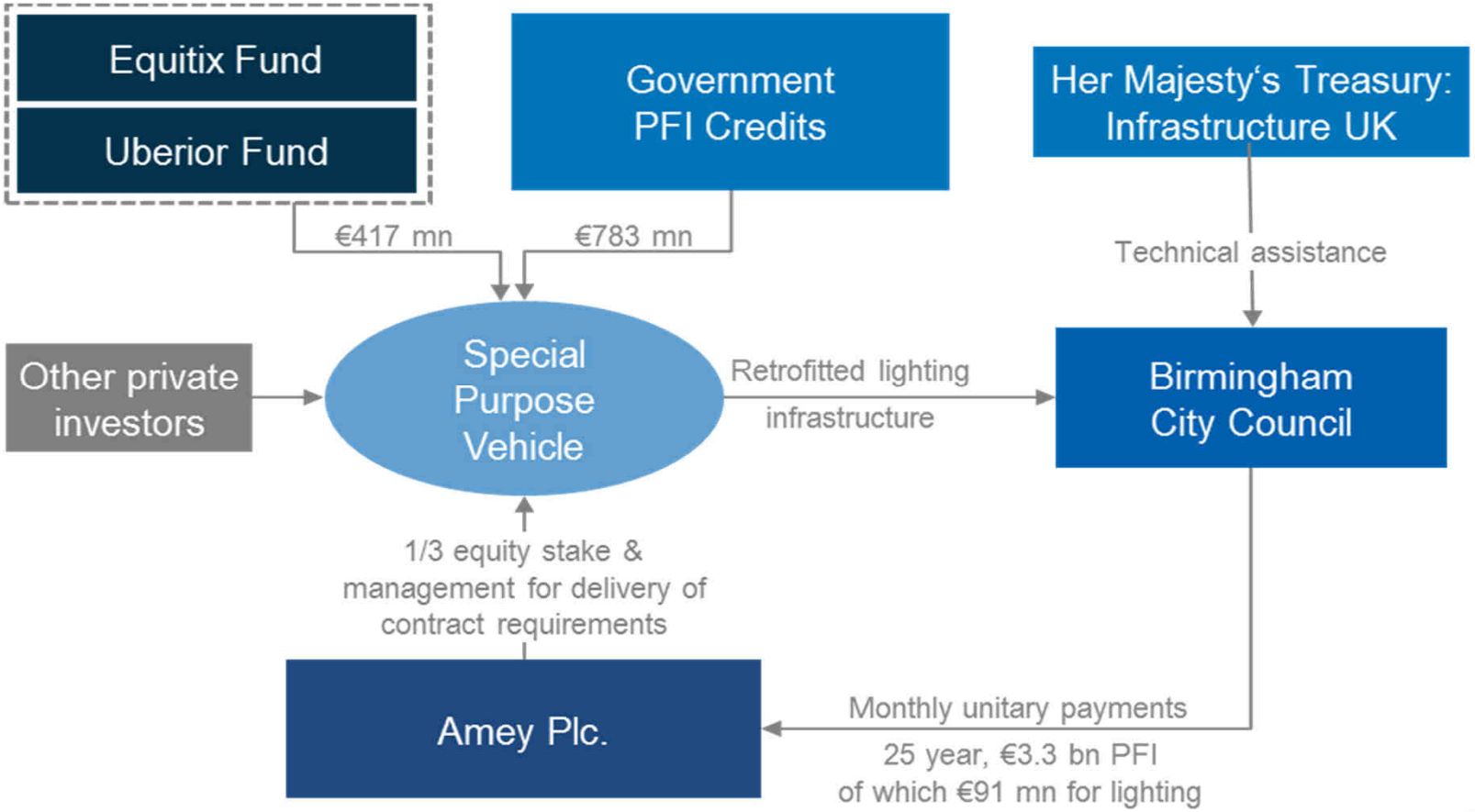
PPPs | Model 3: Project finance

- A Special Purpose Vehicle (SPV) is founded, financed by equity from private investors, debt from lending institutions and contributions from the municipality
- The SPV carries the investment project on its balance sheet



Source: Novikova et al. (2018)

Project finance
Case study - Birmingham (2007 – …)

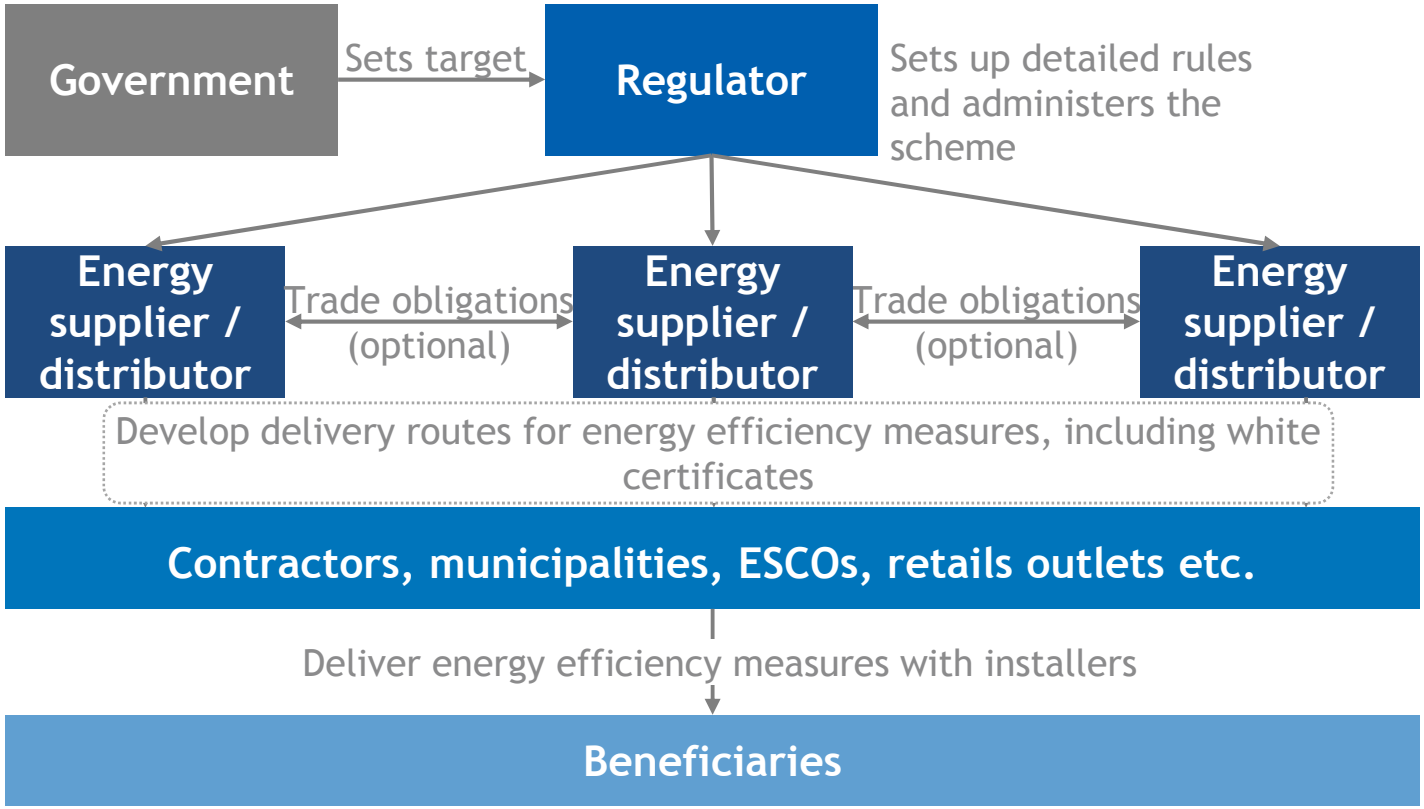


Note: PFI- private financing initiative
Source: Makumbe et al. (2016) in Novikova et al. (2018).

Financing by utilities

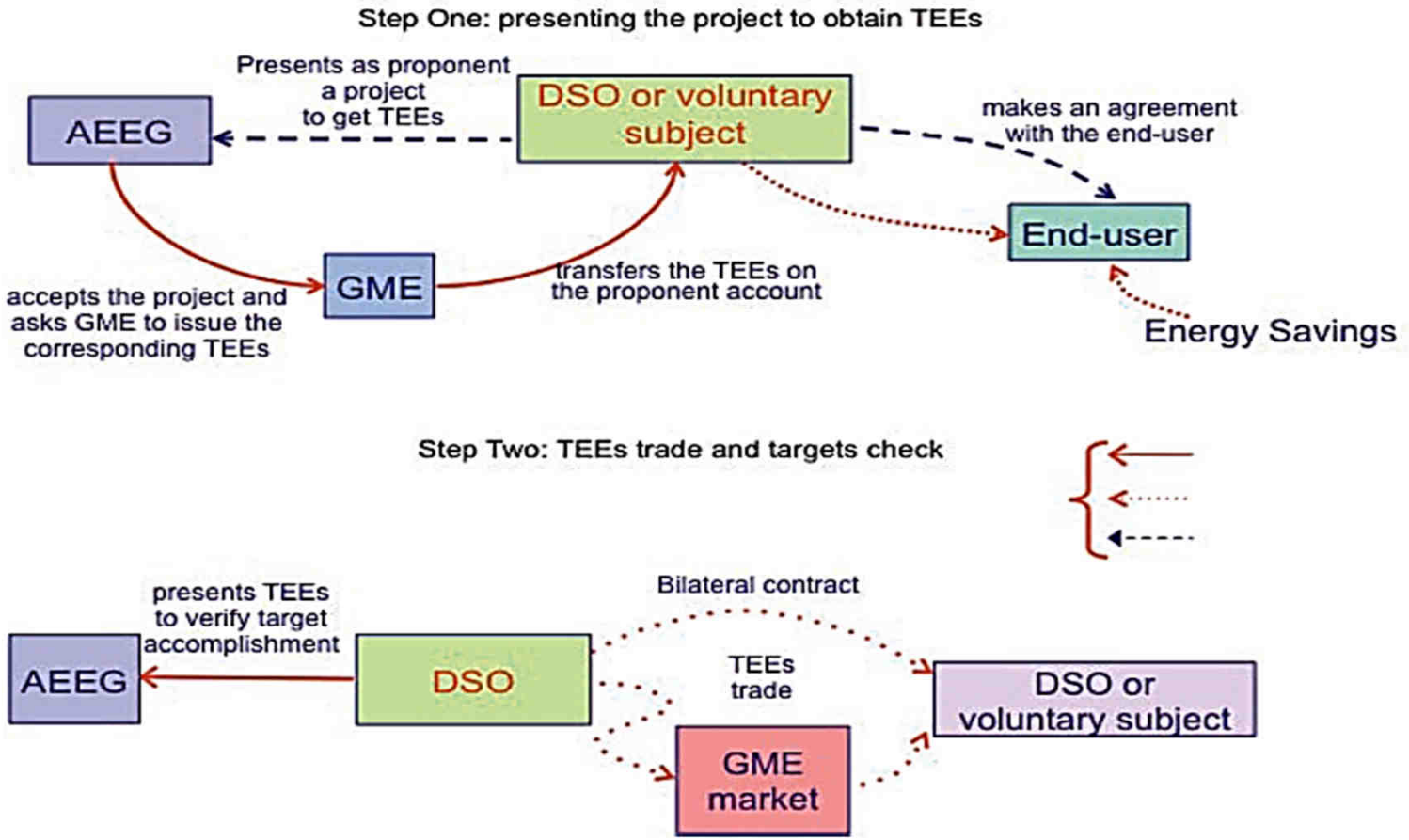
Financing by utilities | Model 1: Energy Efficiency Obligation Schemes (EEOS)

- The utility provides a loan to the municipality, which pays it back through its energy bill – based on energy savings



Source: Rosenow (2017) in Novikova et al. (2018)

Energy efficiency obligation schemes
Case study - Italy



Source: Di Santo et al. (2011) in Novikova et al. (2018).

Financing by utilities | Model 2: On-bill financing

Architecture

- The utility provides a loan to the municipality, which pays it back through its energy bill – based on energy savings
- The utility can oversee and require specific technology use for upgrades

Advantages

Municipalities:

- Can finance their projects directly over the utility company
- Repay their loan via their energy bill, not suffering additional administrative costs

Projects that could be financed

- In principle easy to implement and set up for small to medium investments

Disadvantages

Municipalities:

- Need to repay their loan long-term, having it on their own balance-sheet

Source: Novikova et al. (2018)

On-bill financing
Case study - California, USA (2004-ongoing)

Project overview

- The utility Pacific Gas and Electric (PG&E) provides zero interest rate loans to municipalities in northern California
- Southern California Edison (SCE) has a similar scheme for southern California

Project scope

- PG&E and SCE each provides loans between 5,000-250,000 USD to public institutions
- To qualify for a loan, estimated savings have to be enough to repay it

Financing structure

- Loans are payed back monthly via the energy bill
- Loans are refinanced by estimated energy savings by the efficiency measures

Implementation & outcome

- As of 2016, several hundred projects have been realized
- More than 180,000 luminaries were upgraded by on-bill financing of PG&E

Source: US DOE (2016) in Novikova et al. (2018).

Financing by citizens

Financing by Citizens | Model 1 Crowdfunding

Architecture

- Raising funding online on platforms where investors and project developers meet
- Investors can freely pledge there money to projects they like to support
- Models can be lending- or reward-based

Advantages

Municipalities:

- Build a community around their project
- Freely decide on what return investors should get
- Split their finance in regular ways of funding and crowdfunding

Projects that could be financed

- In principle any project can be crowdfunded as long as it can raise enough attractiveness and hence funding

Disadvantages

Municipalities:

- May suffer issues of responsibility to a vast amount of small investors
- Have no guarantee that investors stick to a project throughout the funding phase

Source: Novikova et al. (2018)

Conclusion

- There is no model which is best for every set of individual customer needs
- Models differ in complexity, degree of autonomy of the municipality, risk sharing between municipality and an eventual private partner, number and kind of involved partners, costs, running time, etc.
- Consulting an expert before deciding on a model is highly recommended
- At a later stage, the "Dynamic Light" project will provide a guideline on how to find the most suitable model

Thank you!

Dynamic Light website with all deliverables:
www.interreg-central.eu/Content.Node/Dynamic-Light.html

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