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CLIMATE TECHNOLOGY CENTRE & NETWORK

Activity 4 Report

"CTCN Technical Assistance: Energy Efficient Street Lighting Technologies and Financing Models in Thailand"

Development of Financial Models for Implementation

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Introduction

The Provincial Electricity Authority (PEA) provides electricity services to more than 1,000 cities and towns throughout Thailand and more than 65% of all electricity consumed in Thailand is within PEA's service areas. In terms of geographical coverage, PEA distributes electricity to 99% of the country and has more than 900 sub-offices throughout 73 provinces. PEA has partially subsidized electricity expenses for street and outdoor lighting in their service areas for decades and annual electricity consumptions by these street and outdoor lighting applications increased more than two-fold over the past 10 years, from 996-gigawatt hours (GWh) in 2005 to about 2,138 GWh in 2014.

Although PEA has shouldered electricity expenses for street and outdoor lighting in Thailand, its involvements in developing and implementing relevant national energy efficiency standards for street and outdoor lighting have been very limited. In general, installation and maintenance of street and outdoor lighting in PEA's service areas lie with the three following organizations:

- Department of Local Administration (DLA);
- Department of Highways (DOH);
- Department of Rural Roads (DORR).

DLA is under the Ministry of Interior and governs all municipalities in the country, while DOH and DORR are under the Ministry of Transport. These government agencies do not harmonize relevant standards for street and outdoor lighting, and each agency has its own classifications of roads and specify slightly different lighting quality requirements (illumination and uniformity) for each road classification. High Intensity Discharge (HID) technologies, such as High-Pressure Sodium (HPS) lamps, Mercury Vapor (MV) lamps, and linear fluorescent lamps (FL) are the common lighting technologies in PEA's service areas, and these conventional lighting technologies are included in the guidelines and regulations issued by DLA, DOH and DORR.

HID and FL lighting technologies commonly used in PEA's service areas need reflectors attached behind the lamps in the luminaires to direct light to where it is needed, and much of the light is lost – at least 20% to 30% for new luminaires and the loss figures are higher for old luminaires. These types of luminaires also produce light pollution in the surrounding area, which leads to inconvenient glare for drivers and pedestrians and may cause roadway hazards. FL luminaires have similar characteristics as of the HID luminaires but fluorescent lamps have poorer efficacy than HPS lamps. It should be noted that over the past few years, Thai municipalities have become familiar with Light-Emitting Diode (LED) technologies, and small-scale installations of LED luminaires and LED tubes have been carried out by Thai municipalities. However, the overall penetration of LED technologies in the street and outdoor lighting sector in Thailand is still limited. Lack of well-structured financing packages for energy-efficient projects is often a key barrier to their implementation and to the widespread adoption of energy efficient technologies. This report focuses on identifying suitable financial models for mainstreaming energy efficient street lighting technology in regions under PEA.

In earlier reports selection of suitable Energy Efficiency Technologies suitable for implementation in Thailand was done along with detailed techno-economic study for Lampang Municipality, Nakornsawan Municipality and Pathumthani municipality. The financial cost of implementation of energy efficient street lighting technologies were calculated as below:

Municipality	Estimated investment cost (US$)	Annual cost savings (US$)
Lampang	**658,890**	**292,822**
Nakornsawan	**205,695**	**125,886**
Pathumthani	15,339	10,297
Total	897924	429005

Together the total investment required for up-gradation of the street lighting systems in these municipalities is US$ 897,924 with payback by annual cost savings in 2.1 years. The finance can be obtained from the national or international entities like Banking Institutions, National Development Banks, Bi/ Multilateral Development ESCOs(Energy Saving Company) Guarantee institutions or the Utility (PEA) itself can finance. The PEA can also raise capital from the private entities and market using green bonds. There are various financial models under which the implementation of Energy efficiency street lighting projects can be implemented.

PEA has since 2004 implemented some projects under its own investments for equipment purchases, however large scale implementation was not found feasible. Since then many projects of energy efficiency were implemented using the Energy Service Company Approach. Under this approach, PEA has entered into agreements with local ESCOs which provided initial investments and installation of the equipment including operation and maintenance (O&M) throughout the contract. ESCOs will then gradually recover the investment cost from the repayments made by PEA through the energy-saving gained as agreed in the contract. PEA has successfully implemented many energy efficiency street lighting projects using the abovementioned ESCO approach since 2007. Several public and private ESCOs have been contracted by PEA, including Kasetsart University (KU), King Mongkut's University of Technology Thonburi (KMUTT), Burapa University, Philips Lighting and L&E.

There are many financial models for implementation of energy efficiency projects, these financial models are listed in the annexure. The selection of adequate model should be done by the stakeholders depending of what financial and technical burden of implementation of such projects can be taken up by stakeholders and flexibility of the regulatory framework to adopt the measures required to implement the project.

PEA shoulders the electricity expenses of the street and outdoor lighting, but the installation, operation and maintenance is done by other entities. In some cases, PEA does the installation if other entities don't have adequate institutional capacity. These entities are individual local authorities falling under the Department of Local Administration (DLA), Department of Highways (DOH) and Department of Rural Roads (DORR). There are multiple challenges in the implementation of Energy Efficiency Projects in Thailand. Major

challenges faced in policy, institutional mechanisms, technical capacity, and financing of the energy efficient street lighting projects are described below.

Policy Challenge: Municipal street lighting EE projects face a number of challenges, such as inflexible procurement systems and the lack of policy support. In the absence of relevant policies and incentives for implementation of energy conservation measures, municipalities are hesitant to face the technical and financial burdens of efficiency improvements. Government procurement procedures tend to favour lowest-cost technology replacements and investments that achieve rapid service improvements but often result in inefficient structures and equipment systems.

The study of regulation, standards and guidelines for public and street lighting design in Thailand found that the existing legal documents (such as acts and ministerial regulations) related to public and street lighting in Thailand stipulates only duties and responsibilities of the abovementioned organizations and authorities related to the provision of roadway and public lighting as public services. There are neither rules/regulations nor national standards for public and street lighting design and O&M.

With regard to energy efficiency requirements for public and street lighting, the Department of Alternative Energy Development and Efficiency (DEDE) has authority to regulate and set the policy measure on energy efficiency, however no legal measures related to saving energy from the use of energy-efficient street lights have been developed or adopted by DEDE.

Institutional Challenges: one of the greatest barriers to street lighting energy-saving initiatives in Thailand is the lack of adequate technical and managerial capacity within municipal bodies to upgrade the street lighting design and implement efficiency measures. Without proper policy support institutional capacity slowly becomes outdated resulting in missed opportunities of savings at a national scale.

The key barriers hampering the future scaling-up of LED retrofits for street and outdoor lighting in PEA's service areas include: a lack of proper financial mechanisms; and limited capacity at the local government level to handle large scale projects.

Technical Challenge: While designing or making changes to street lighting, it is important to first understand the lighting requirements of the roads. The most common reasons for inefficient street lighting systems in municipalities include:

a) Inadequate understanding and analysis of required service levels;
b) Need for a more rigorous approach to selecting appropriate luminaires;
c) Poor lighting system design and installation;
d) Poor or inconsistent power quality; and
e) Poor operation and maintenance.

Many projects in the past have not been able to deliver the expected outputs and benefits and have resulted in disputes over quantification of savings primarily due to issues related to baseline establishment. Some demonstration sites have successfully demonstrated LED luminaire useful lifetime of more than 30,000 hours (around 7 years), while some demonstration sites indicated a useful lamp life of only around 10,000 hours.

Financial Challenge: Given the constraints on municipal budgets, financing for municipal projects must often come from other sources. These are often constrained by the conditions imposed by the grantors, lenders, or co-investors for contributing their resources to

municipal projects, especially if they are based on performance contracts. Grantors need assurance that the money they provide to municipal projects will be used for its intended purpose. Lenders and co-investors need a guarantee of repayment and receiving their agreed-upon share of a project's payback. Local financial institutions and banks lack the technical knowledge to evaluate energy efficiency projects, based on their energy and cost-saving potential, especially where it is **cash-flow based financing, rather than the traditional assets or collateral-based financing**. Lack of access to financing for such projects is often perceived to be a key barrier to their implementation. Access to financing also depends on the creditworthiness of the borrower, the cash flow to be generated by a project, and available mechanisms for credit enhancement (such as collateral and loan guarantees). Recent successes of green municipal bonds in some countries offer renewed hope that innovative financing instruments can be used to generate better financial packages to implement energy-efficient street lighting projects. In the case of Thailand since we have two separate entities 1. The owner of street lighting system i.e. urban local body and 2. PEA who shoulders the cost of electricity, the complexity of the financial model will vary from the market practice.

As per the techno-economic study carried out for Lampang, Nakornsawan and Pathumthani Municipality, retrofitting or replacing existing HID/FL luminaires with LED luminaires in PEA's service areas are considered to be cost-effective The average simple payback periods range from about 3 years to slightly over 6 years, depending on the tariff rate applied. It is envisioned that the payback periods for large-scale LED investment in PEA's service areas will be shorter due to lower unit costs from bulk purchasing. Large-scale implementations (installations of more than 10,000 luminaires annually) have also been successfully undertaken internationally. These implementation experiences have also confirmed that the cost of LED street lighting has been decreasing rapidly and applying a bulk procurement approach could further reduce the unit cost of LED luminaires with extended warranties (5-7 years).

Measurement and verification is a very important aspect of the implementation of energy efficiency in street lighting projects. PEA has a very high metering rate for street and outdoor lighting. Savings from LED street lighting can be monitored through the electricity bills. Additionally MRV framework for implementation of the EE street and outdoor lighting in Surabaya can follow the approved CDM methodology AMS.II-L (Demand-side activities for efficient outdoor and street lighting technologies), as it provides guidelines for measuring and calculating the energy consumptions for both metered and non-metered light points, emission reduction, and lighting quality.

The next chapter of the report focuses on different financial mechanisms, business models and risk coverage mechanisms designed to encourage investments in energy efficiency projects in public projects like street lighting.

Financial Models for Public Infrastructure Projects

Public Private Partnership (PPP):

Under this model private sector is used to design, build, finance and operate the street-lighting infrastructure which is traditionally done by public sector. It may be appropriate to use the private investment for project which are large or having higher risk. PPPs are normally designed as long term contract, typically 20 or more years. Private sector constructs and maintains a project's physical asset and raises the required funding, usually on a project finance basis where contractual payments from public sector are the primary security for the funders. The general goal is to ensure the lifetime costs of such public assets are minimized and required services and competitively provided.

Under PPP, the private sector firm creates or maintains the public asset at its own cost. The public sector counterpart agrees to cover the costs over time, including the cost of capital which is typically higher than if the public sector had funded the project.

The key advantage of PPPs for municipalities is the source of capital, which is typically the private sector; national governments may incentivize PPP contracts by offering supplementary grants. There is no need for a municipality to raise up-front capital.

Benefits

- Using PPP instead of conventional public procurement offers optimal risk sharing with a private partner and therefore it is a better value for the public user.
- PPP offers policy makers to improve the delivery of services and management of systems.
- Mobilization of private capital, demand for investment in a large scale project may overshoot the available resources of government. Access to private fund can speed up the delivery.

Challenges

- PPP arrangements are more complex than conventional public procurement processes. They require detailed project preparation and planning, and proper management of the procurement phase to spur competition among bidders.
- Careful contract design to set service standards, allocate risks, and reach a reasonable balance between commercial risks and returns these features require skills in the public sector that are not typically called in conventional procurement.

Support Mechanisms:

- Green Credit line and other sources of private equity.
- ESCOs
- EPCs

Revolving loan fund: Revolving loan funds are an effective way to encourage public sector investments in energy efficiency. Revolving loan funds start with a fixed pool of capital, which is leant to end users for projects that fit a specific purpose, such as energy efficiency upgrades. The loan is then repaid to the fund, often with a small amount of interest. The replenished money can be re-lent to new end users in a revolving manner. In most case the interest paid by the end users is used to pay the administrative fees for the fund. Public sector focused revolving loan funds are typically managed by a government agency or by a government-backed entity.

Benefits

- The key benefit of public sector revolving loan funds are that they are typically offered at very low interest rates with longer term tenors than available from commercial banks.
- In some cases, repayments can be matched with utility bill savings that result from the improved efficiency, meaning that the public entity would not notice any substantial difference in their expenditures.
- Revolving loan funds can be well suited to the public sector energy efficiency projects as public sector bodies typically rely of the government based sources of revenues, or a combination, and less so on financial institutions.

Challenges

- They require initial pool of funding which is often limited or can be difficult to source. For many infrastructure projects using public sector revolving fund, the initial funding is sourced through public channels, for projects of street lighting the initial source can be funded from energy ministry.
- The sources are often limited and once the initial pool has been lent more landing cannot occur until the repayments are made.
- Revolving funds have large administrative costs.

Supporting mechanisms

- Energy Performance Contracts

Energy Performance Contract- Shared and Guaranteed savings models (ESCOs):

Energy performance contracts (EPCs) enable funding of energy efficiency upgrades from cost reductions. Under an EPC arrangement, an external organisation, typically called an Energy Service Company (ESCO) implements an energy efficiency project and uses the stream of income from the cost savings to repay the project costs. The ESCO only receives full payment if the project delivers predicated energy savings; this transfers project technical risks from the client to the service provider.

There are two major contracting models defining the relationships and risk allocations among the ESCO, customer and lender: the shared savings model and the guaranteed savings model.

In shared savings models, the ESCO invests in the project. The cost savings resulting from the energy upgrade are quantified, and for the duration of the contract a pre-determined share of this amount will be used to remunerate the ESCO. The ESCO thus takes over both the performance and the customer credit risk, and acquires financing.

In guaranteed savings models, the ESCO guarantees a certain level of energy savings by covering, in case of underperformance, the monetary value of the difference between predicated and actual energy bill savings based on a specified utility rate. This shields the customer from any performance risk. The customer is directly financed by a financial institution, repays the loan and assumes the investment repayment risk. The feasibility of EPC projects depends on the predictability of energy use, the level in energy efficiency, the price of energy, the size of the investment, the complexity of the project, and the legal, financial and regulatory rules. Street lighting improvement project provide great opportunities for ESCOs to develop projects since the energy consumption of these projects are often predictable and load variation is small.

Benefits

- Reducing or eliminating the performance risk and need for internal technical expertise.
- Incentivising the ESCO to provide state-of-the-art products and services and to optimize its operation to achieve high energy savings.
- In the case of the shared savings model, the customer does not have to invest and the project is financed off balance sheet.

Challenges

The main risks and challenges to establish EPC arrangements in the case of shared savings contract:

- Possible payment default of customer after installation.
- Uncertainty of baseline measurement and unexpected increase in installation costs.
- Leverage problems for ESCOs who can become too indebted.
- An adversarial relationship between the ESCO and customer can be created because higher than expected measured savings translate into higher payments to the ESCO.

The main risks and challenges to establish EPC arrangements in the case of guaranteed savings contract:

- The guaranteed savings concept is also exposed to uncertainties with the baselinemeasurement, and can be difficult to implement in developing markets because it requires customers to assume investment repayment risk.
- Energy Savings Insurance adds additional risk mitigation mechanisms to EPCs and facilitates adoption in developing countries

Support Mechanism

- Shared-savings EPC models can be supported by financial tools to recapitalise the ESCOs such as sale and leaseback or the securitisation of cash flows, by risk mitigation mechanisms such as payment guarantees to reduce the risk of default from the end-client and by positive lists.
- Guaranteed-savings EPC models can be supported by standardised contracts, independent validation entities, additional insurances to cover the customer in case of non-compliance by the ESCO, credit guarantees to support the client to assume the investment repayment risk and by positive lists.

Crowd funding and crowd lending:

Crowd funding is the mobilisation of funding for projects from a large number of investors using internet-based platforms and online processes. Crowd funding can take different forms (i.e. donations, rewards, crowd-lending or debt, equity, royalties), which can be split into two categories: community crowd funding and financial return crowd funding

Crowd funding for energy efficiency (CF4EE) can be used when there is a lack of affordable financing or high upfront costs for implementing or scaling up cost-effective energy efficiency measures. A typical CF4EE process follows the following steps.

- A project developer or Energy Service Company (ESCO) enters into a contract with crowd funding platforms (CFPs) defining the fees, terms and conditions.
- The energy efficiency project is listed on the website of the CFPs and the fundraising campaign kick starts with a real-time project funding process for potential investors.
- Potential investors pledge amounts online and enter into individual investment agreements after security and financial clearance
- Crowd-lending investors provide a loan to the project developer expecting both interest payments and principal return later on or offer to acquire a share in the project
- The project developer can then mobilise the funding to finance upfront costs of the energy efficiency project
- The public entity pays back the project developer through a financing mechanism, such as a lease purchase agreement over a fixed period of time with annual payments

Benefit

- Debt and equity crowd funding can scale-up energy efficiency projects and enable the public sector tap energy efficiency and cost savings potential without investing public money.
- Encourages investors to increase their risk tolerance by offering greater diversification and smaller amounts per investor

Challenge

- Crowd funding can be financially viable (i.e. have attractive Internal Rates of Return (IRRs)). However, returns can become very low once crowd funding and project developer costs, i.e. 10 to 20% of the funds raised, are factored in.
- Legal uncertainty because regulations are missing or are inappropriately adopted from existing pre-crowd funding legislation.
- Utilities are indirect beneficiaries of savings.

Supporting Mechanism

- Lease purchase models
- Shared savings contracts
- Guarantees

Green Bonds:

Green bonds typically fund large scale, capital-intensive, green infrastructure projects that can be repaid by steady, modest, long-term cash flow. Bonds, including green bonds, are less appropriate for funding new techniques with higher default risk. Likewise, bond investors tend to be more risk averse, opting for the low risk, low return vehicle of a bond. Issuers of green bonds are expected to provide third-party reviews of the green credentials of projects at the time of issuance in addition to post-project reporting or verification about how the funds were used. Bond Issuance can come from any organization with bond issuance authority as per the countries regulatory framework. Green bonds are well suited for bond investors with a long-term investing horizon and a low to moderate risk appetite.

Credit rating:

Credit ratings are an important tool to facilitate lending allowing investors to compare risk and return metrics on an 'apples to apples' basis. several Leading credit agencies, such as Standard &Poor's, Moody's, Fitch, and Kroll, have begun to review and rate green bonds using the same credit ratings used to rate regular bonds making the financial credibility of the underlying asset and/or institution directly comparable. In addition, credit ratings help validate new, creative bond projects e.g. Energy Efficiency Projects.

Supporting mechanism

- ESCOs
- Shared savings mechanism

On-bill financing models:

On-bill financing is an innovative approach to financing energy efficiency upgrades for municipalities and public buildings. The model enables energy utility customers to acquire energy efficient equipment, such as air conditioning and lighting systems, and to pay for the equipment over time through their monthly utility bills. In many cases, on-bill programmes are designed to deliver overall cost savings from the very first day without the need for the

customer to invest (bill neutrality). This means that the energy cost savings equal or exceed debt service, resulting in a lower total bill (debt repayment and electricity) after retrofit.

Through on-bill financing, utility customers can purchase efficient equipment with their regular technology provider, who facilitates the credit request. There are several ways to structure on-bill financing models:

- In one approach, the utility incurs the capital cost of the energy efficiency upgrade, which is repaid through the utility. The utility thereby effectively takes on the role of a financing entity in addition to selling electricity.
- Another approach, sometimes referred to as "on-bill repayment", the upfront capital is provided by a third party, typically public or private financial institutions, rather than the utility. In exchange for a management fee, the utility acts as a repayment conduit, collecting the payments through the electricity bills for the original lenders.

Benefits

- The biggest customer benefits of this model are the avoided upfront capital expenditure and the ease of repayment. This can help motivate investments that may not otherwise happen. On-bill financing models tend to have low default rates. This is because the loan has bill neutrality, as well as due to the tendency to prioritise utility bill payments and, where allowed, the utility's ability to shut off service in the event of non-payment.
- The increased energy efficiency on the demand side benefits utilities on the supply side through the avoided cost and risks of building additional power plants, new power lines, substations, and transformers.

Challenges

- Engaging the utility to support the transition towards energy efficiency and/or to serve as a financier.
- Changing the utilities data and information management system to allow for on-bill repayment.
- Repayment allocation (i.e., whether utility or lender is paid first) can be an issue when customers partially pay their bills.

Support Mechanism

- On-bill financing can be supported by capitalizing new on—bill loan funds through credit enhancement for existing on-bill funds , such as loan guarantees

Leasing:

A lease is an arrangement in which one party (the lessor) conveys the use of an asset to another party (the lessee) for a specified period of time in exchange for periodical payments. There are two basic forms of leasing: operating leasing and finance leasing. The differences between the two involve: who owns the leased asset; what accounting and tax treatment applies; who bears the expenses and running costs; whether the contract includes a purchase

option, and; the lease term length. Leases can be offered directly by the technology supplier (vendor lease), by a financial institution, or by a third-party such as a leasing company.

Benefit

- Leasing arrangements benefit customers from the public sector by avoiding upfront capital investments, the possibility to use the equipment itself as collateral, the lack of restrictive covenants, industry-leading equipment without the risk of obsolesce, flexible arrangements in which the equipment might be returned or purchased during the contract period, and a transparent and predictable pricing structure.
- In case of an operating lease, the model converts client capital expenses into operational expenses, affording the client tax benefits and other advantages such as off balance-sheet financing. Both forms of leasing free-up capital for other investment priorities.

Challenges

- Regulations in the country must allow multi-annual financing for municipalities /public buildings.
- Regulatory barriers, preventing leasing without a license by the central bank.
- The legal and tax environment make it less attractive for financial institutions to offer leasing than loans.
- Resource constraints: leasing investment involves significant capital outlay for the lessor, which is a challenge for vendor leases.
- Risk of obsolescence for the lessor in case of short contracts and rapidly-evolving technology.
- The lessor faces the risk of delay in rental payments or payment default, which can be reduced by evaluating the credit risk of customers, and by mechanisms such as payment guarantees and equipment reallocation procedures.
- Equipment reallocation procedures can face legal challenges when the equipment is installed on the client’s property and should be considered when designing the leasing contract.

Support mechanism

Leasing models can be supported by risk mitigation mechanisms such as **payment guarantees** to reduce the risk of default from the end-client, by carefully analysing the credit risk of the clients, and by validating the technology.

Bulk Procurement:

Innovative, high-efficiency and high-quality products often face barriers to market entry, from price to lack of product recognition. Market transformation tools like bulk procurement help bring these products to market at an accelerated pace. Bulk procurement is a no-subsidy, demand-driven mechanism that provides economies of scale, enabling manufacturers to bring down their prices through successive rounds of efficient and

transparent bidding to create a large and sustainable market for energy efficient technologies.

Government authorities or utilities issue tenders with a set of qualifying criteria to buy large numbers of energy efficient products, while manufacturers compete on price bids. In each round, multiple bidders are selected and all of them are asked to match the price of the lowest bidder. The volume of the bid is then allocated to all the manufacturers who agree to match the lowest price in the bid. Aggressive bidding by manufacturers and the exclusion of regular dealers and retailers tend to drive down the price of procured energy efficient products. Improved manufacturing and competition lower retail market prices for the targeted energy efficient products as well.

For instance, using bulk procurement, India is implementing the Street Lighting National Program (SLNP) where government authorities or utilities retrofit conventional streetlights with LED light bulbs in municipalities or cities and maintain them for a certain period of time. Parties enter into long-term annuity agreements using a savings approach and monthly instalments. The entire investment is made upfront by government authorities or utilities and recovered along with operation, maintenance, and financing costs, from the energy savings of municipalities and cities over time. Building on the success of SNLP, India is expanding its programs to new market segments that offer significant opportunities for EE, including the Building Energy Efficiency Program (BEEP) for energy efficiency in public buildings, by procuring the necessary equipment for carrying out retrofits, payable under a guaranteed savings approach or ESCO model.

Benefits

- With bulk procurement, large-scale energy efficient technology deployment is feasible without government subsidies.
- Repeated tenders of bulk procurement increases and improves domestic manufacturing capacity and fosters competition. Buying directly on a mass scale reduces risk for manufacturers.
- Bulk demand is also a strong economic incentive for manufacturers to invest more in local assembly lines and lower their costs. As the model allows manufacturers to deal with one procurement agency or entity, they can bypass distributors and retailers and save transportation costs.
- By aggregating the demand for a certain product on a national scale, bulk procurement has the potential to transform markets.

Challenges

- The potential for product cost reduction through bulk procurement depends on the volume of tenders and the number of suppliers in an energy efficient product market. If both are small, the potential will be limited. Also, retail market disturbances could be challenging if withdrawal plans from bulk procurement are not well-prepared.

Support Mechanisms

- Long-term annuity agreements to finance LED streetlights in the public sector (i.e. deemed savings approach and monthly instalments).
- Guaranteed savings or ESCO model to finance energy efficiency retrofits for public buildings.
- Credit guarantees and concessional loans to help government authorities and utilities access new commercial financing sources and scale-up bulk procurement programmes.
- Policies and regulations, voluntary labelling and standards to increase energy efficiency technologies uptake, quality and efficiency.

Municipal financing models:

Municipal financing models involve revenue and expenditure decisions by municipal governments to fund energy efficiency projects in the public sector.

Common sources of municipal revenue include taxes, user fees, inter-governmental transfers, investment income, property sales, and licenses or permits. Municipal financing models finance energy efficiency infrastructure through the use of operating revenues and borrowing, as well as through charges on developers and **public-private partnerships** (PPP). Municipal finance also addresses issues around expenditures at the local level, including expenditure accountability and revenue decisions made through budget processes and financial management.

A municipal government with weak credit or little-to-no borrowing capacity will not be able to access commercial financing or engage in leasing or **energy performance contracts**. In these cases, cities may be limited to relying on budget financing or energy efficiency funds established by governments or donors. A municipality with stronger credit and borrowing capacity can use a larger number of financing options (e.g. **credit lines**, **risk guarantees**, etc.)

If the municipal financing model relies on budget revenues, the municipal government typically uses a mix of local taxes and national government transfers to feed annual capital funds for infrastructure investments such as LED street lighting. The funds are tapped to acquire the necessary energy efficiency retrofit equipment from a technology provider who is selected through a competitive bidding process (i.e. national or international procurement.) The winning bidder undertakes equipment installation, in addition offering a fixed-term warranty covering equipment replacement and repair.

Benefits

- The main advantage of the municipal financing model is that financing costs are low.
- The main disadvantage is that municipal programmes can take a long time to develop, depending on the availability of municipal resources.
- When energy efficiency projects are not fully owned by the local government, such as street lighting (see case study below), the question of asset ownership and financing arrangements between owning entities is challenging. The share of ownership

determines the extent of expected energy savings that in time impact the project financial viability (payback time).

Supporting Mechanism

Supporting mechanisms for municipal financing models include energy efficiency policies to promote energy efficiency investments such as minimum energy performance standards, which improve procurement processes and increase bid quality, and building inspection and evaluation procedures to ensure procured energy efficiency equipment compliance and performance.

Conclusion:

Even though the upgrade of street lighting offers high energy savings, its upgrade rate is low in many municipalities in Thailand. High up-front investment costs are among the highest barriers for municipalities to upgrade street lighting. The most straightforward financing model is to pay for street lighting upgrades from the own funds of municipalities. To minimize the burden on taxpayers, the public sector could design and implement additional schemes which help raise the funds to the budget, in particular, the revolving scheme.

Many municipalities, whose own funding resources are limited, obtain debt which is then be paid back from the tax revenue of municipalities and/or saved energy costs. Thus, the municipalities could obtain a low-interest loan from a public lending program, a commercial loan from a bank, or it could issue municipal bonds.

Another alternative for the municipal actors is to reallocate the burden of financing street lighting infrastructure on third parties, e.g. contracting an energy service company. There is a wide variety of such contracts. In a simple contracting model, the contractor directly receives a contracting fee, which covers the costs of planning, financing and execution of the infrastructure upgrade, as well as its margin. The municipality is not involved in the contractual relationships with a bank providing the funds. In a more complex model with forfeiting and waiver of defence, the roles of the municipality and the contractor are similar to the simple contracting model, but the bank enters into agreements both with the contractor and with the municipality.

The other configuration is a set of energy performance contracting models, which could be applied when either a municipality or the contracted party pays for energy supply. In this model, the energy cost savings achieved via a reduction of energy consumption are used to finance the street lighting upgrade. Typically, the contracted energy service company guarantees an energy-saving level to be achieved. In some models, additional energy savings achieved on top of the guaranteed level are shared between the municipality and the contractor.

Each of the models has its advantages and disadvantages as well as constraints to do with the economic, market and legal conditions in which it could be applied. Therefore, the choice of model should be made according to the specific conditions in each municipality.

Concerned divisions / project related brief note to be included here

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