SUSTAINABLE PUBLIC PROCUREMENT

TOOLKIT FOR LIGHTING, APPLIANCES AND EQUIPMENT

United Nations Environment Programme – Global Environmental Facility – Department for Environment, Food and Rural Affairs | United for Efficiency (U4E)

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Acronyms

AC	Air Conditioner
ASEAN	Association of Southeast Asian Nations
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
CCT	Correlated Colour Temperature
CFC	Chlorofluorocarbon
CFL	Compact Fluorescent Lighting
CRI	Colour Rendering Index
CSPF	Cooling Seasonal Performance Factor
CSR	Corporate Social Responsibility
DFI	Development Financial Institution
EMS	Environmental Management System
ESA	Energy Services Agreement
ESCO	Energy Services Company
ESG	Environmental Social and Governance
ESPC	Energy Savings Performance Contracting
EV	Electric Vehicle
FI	Financial Institution
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GP	General Purpose
GPP	Green Public Procurement
GWP	Global Warming Potential
HC	Hydrocarbon
HCFC	Hydrochlorofluorocarbon
HFC	Hydrofluorocarbon
HFO	Hydrofluoroolefins
HP	High Performance
HPMV	High Pressure Mercury Vapour
HPS	High Pressure Sodium
IEC	International Electrotechnical Commission
ILO	International Labour Organization
IMF	International Monetary Fund
ISO	International Standards Organization
LCC	Life Cycle Cost
LED	Light Emitting Diode
M&V	Measurement & Verification
MDB	Multilateral Development Bank
MEPS	Minimum Energy Performance Standard
MESA	Managed Energy Services Agreement

ODS	Ozone Depleting Substance
OECD	Organisation for Economic Co-operation and Development
Pst	Short Term Flicker Perceptibility
RAC	Refrigeration and Air Conditioning
SME	Small and Medium Enterprise
SPP	Sustainable Public Procurement
SVM	Stroboscopic Visibility Measure
U4E	United for Efficiency
ULOR	Upward Light Output Ratio
ULT	Ultra-Low Temperature
UNCITRAL	United Nations Commission on International Trade Law
UNEP	United Nations Environment Programme
VAC	Volts in Alternating Current

1 Introduction

The concept of Sustainable Public Procurement (SPP) combines two aspects of government endeavour, namely the process of public procurement and the pursuit of sustainable development[1]:

(a) Public procurement refers to the process by which public authorities, such as government departments or local authorities, purchase goods, works, and services from the private sector.

(b) Sustainable development requires governments and organisations to consider the environmental, social, and economic aspects of their operations, with equal emphasis on all three dimensions.

UNEP's SPP Implementation Guidelines[2] (Guidelines) define Sustainable Public Procurement as:

"A process whereby public sector organisations meet their needs for goods, services, works and utilities in a way that achieves value for money on a whole life basis in terms of generating benefits not only to the organisation, but also to society and the economy, whilst minimizing, and if possible, avoiding, damage to the environment.**"**

The term Green Public Procurement (GPP) is sometimes used interchangeably with SPP; however, it should be noted that SPP more explicitly includes the social and economic considerations of sustainable development.

The Guidelines provide a comprehensive, structured framework for implementing a SPP programme through:

Phase 1 Understanding the context
Launch the project, establish governance protocols, conduct initial training, and undertake a status assessment which includes a legal review, stakeholder analysis and review of current procurement practices.

Phase 2 Laying the foundation
Develop an SPP Policy Statement, and an SPP governance and organisational structure.

Phase 3 Action Plan
Create an SPP Action Plan.

Phase 4 Implementing the Action Plan
Deploy SPP throughout the procurement cycle, addressing gaps in the legal framework, prioritising products, conducting pilot implementation, building capacity and performing post-implementation activities.

[1] UNEP (2021) *Sustainable Public Procurement Implementation Guidelines*, yet to be published as of this writing. The previous 2012 version is available at https://wedocs.unep.org/handle/20.500.11822/32157

[2] Ibid.

U4E has prepared this Toolkit to aid with practical implementation of the Guidelines for cooling appliances and lighting, with insights on regulatory, financial and technical considerations.

The Toolkit is structured in the following sections:

Section 2 **Key Sustainability Considerations:** Outlines environmental, social, and economic considerations that are useful at the outset of an SPP programme for cooling appliances and/or lighting. The Toolkit further details these aspects in consideration of typical public procurement processes, with techno-economic analysis, sample procurement specifications and award criteria, external resources, and an action plan for the development of SPP projects.

Section 3 **Barriers to SPP :** Describes financial, awareness, capacity and regulatory barriers. The analysis is useful during the status assessment that takes place during the Phase 1 of the Guidelines.

Sections 4, 5, 6, and 7 support the action plan and the implementation phases of the Guidelines.

Section 4 Economic Analysis of Delivery Models**:** Describes the various modalities to purchase products, their pros and cons, legislative requirements, and accounting and budgeting implications. This content is intended to facilitate the decision-making process by government officials in selecting the most advantageous product model and assessing Life Cycle Costs (LCC) for various options. An Excel spreadsheet tool[3] that enables an LCC Assessment for the various options is also available.

Section 5 **Environmental, Social and Governance (ESG):** Provides sample assessment criteria which may be used during the tendering process to identify and assess the ESG risks associated with the vendors. The documentation is intended to complement standard vendor eligibility criteria if regulations allow such additional elements in the tender process.

Section 6 **Proposed Technical Specifications and Award Criteria:** Provides sample product specifications and tender award criteria which may be used during the tendering process to define sustainable products and select the best proposals.

Section 7 **Proposed Actions of an SPP Policy and Action Plan for Lighting, Refrigerators, and Air Conditioning:** Provides a logical framework to decide the key elements that an SPP Policy and Action plan should include. It also recommends for other mechanisms, such as regulations and fiscal measures that can support the SPP objectives.

[3] Available on the U4E website at https://united4efficiency.org/resources/tools/

2 Key Sustainability Considerations

For procurement to be "sustainable", it should address:

(a) environmental,
(b) social, and
(c) economic considerations.

The assessment boundary includes the product, the vendor, and the delivery model. The relative importance of the assessment components may vary depending on national circumstances, but an illustrative example is provided in Table 1.

Table 1. Relevance of product, vendor, and delivery model on sustainability considerations

	Environmental considerations	Social considerations	Economic considerations
Product	High	Low	High
Vendor	Medium	High	Low
Delivery model	Low	Medium	High

2.1 Environmental considerations

Environmental impacts occur at various stages in a product's value chain, from the initial extraction of material and use of energy and resources for their construction, through operational lifetime and final disposal (and recycling, where available). SPP can readily address the operational and disposal phases. A few key environmental considerations for cooling equipment and lighting are discussed in the following sections.

2.1.1 Ozone depletion

Historically, refrigerants used in typical mechanical cooling systems like refrigerators and many air conditioner applications contained chlorine, a chemical compound that destroys the stratospheric ozone layer protecting Earth from harmful ultraviolet radiation. This discovery resulted in the establishment of the Montreal Protocol, which mandated an orderly phase-out on the production of numerous ozone depleting substances (ODS). The most potent ODS in the cooling industry were chlorofluorocarbons (CFC), which are currently banned in all countries. Their interim substitutes, hydrochlorofluorocarbons (HCFC), have less of an adverse effect on the ozone layer. They are currently being phased out under Article 5 of the Montreal Agreement (which relates to developing countries), with a ban on their use in new equipment entering into force in 2030. In developed countries, HCFC are phased out since 2020. Most of the industry has transitioned to hydrofluorocarbon (HFC)-based refrigerants, which have no negative impact on the ozone layer. Still, some manufacturers offer air conditioners containing HCFC-22 (chlorodifluoromethane), which apart from containing an ODS, will have a shrinking servicing capacity after 2030.[4] In addition to the refrigerant

[4] UNEP OzonAction, "Servicing Tail for HCFCs" Policy Brief, available at https://wedocs.unep.org/bitstream/handle/20.500.11822/31933/HCFCTail.pdf

contained in the cooling circuit, refrigerating appliances are composed of insulating panels that contain foam-blowing agents. Inadequate end-of-life processing may result in the release of foam-blowing agents, which poses a challenge for legacy equipment, as historically they contained CFC-11 (trichlorofluoromethane).[5]

2.1.2 Direct greenhouse gas emissions

HFC-based refrigerants have no harmful effect on the ozone layer, but they and their predecessors (CFC and HCFC) are potent greenhouse gases, which contribute to climate change if released to the atmosphere.

The global warming potential (GWP) of a refrigerant is a measure of the relative climate impact of 1kg of the substance compared to 1kg of CO_2. For example, R-410A (a blend of HFC) is a widespread refrigerant in air conditioning equipment and it has a GWP greater than 2000. This means that the release of one single kilogram of R-410A (the typical quantity in a common 3.5kW capacity room air conditioner) has the same climate impact as two tonnes of CO_2 over a 100-year time horizon.

Lower GWP refrigerants such as HC-290 (propane, GWP<1) or HFC-32 (difluoromethane, GWP of 704) are increasing available, with the latter particularly common. These units, however, may carry a price premium, and require the technicians to receive specialised training to safely install and service the equipment. Units employing other natural refrigerants such as ammonia, carbon dioxide, hydrocarbons, and water exist. However, despite being environmentally superior, these are not free of other concerns, such as corrosion, toxicity, high pressures, flammability, or in some cases lower operating efficiencies. For instance, hydrocarbon-based refrigerants like HC-290 are flammable.

Table 2 describes the GWP classification for refrigerants, and Table 3 and Table 4 provide an overview of the characteristics of popular refrigerants and blowing agents. Table 5 describes the safety group classification according to their flammability and toxicity levels. The safety classification is based on the International Standards Organisation (ISO) 817:2014, which is equivalent to the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Standard 34. It is composed of two elements: a letter (A or B) that indicates the refrigerant's toxicity and a number/modifier that indicates its flammability and is mostly available for compounds with application as a refrigerant.

Refrigerating appliances contain insulation foam to reduce the heat transfer with the ambient environment. Embedded in the foam is a substantial amount of blowing agent, which is used in the manufacturing process to inject the foam into the walls and door and improve its insulating properties. Historically, CFCs were used as blowing agents, which then predominantly transitioned to HCFCs. While low-GWP blowing agents with no ozone depletion potential (ODP), such as cyclopentane, are commonly used, it is important to specify appropriate limits to the ODP and GWP for the blowing agent.

[5] UNEP U4E, "Accelerating the Global Adoption of Climate-friendly and Energy-efficient Refrigerators", p.62. U4E policy guide series, available at https://united4efficiency.org/resources/accelerating-global-adoption-energy-efficient-climate-friendly-refrigerators/

Table 2. Refrigerant GWP naming convention[6]

100-year GWP	Classification
<30	Ultra-low or negligible
<100	Very low
<300	Low
300-1000	Medium
>1000	High
>3000	Very high
>10000	Ultra-high

Table 3. ODP, GWP and safety classification of most common refrigerants used in air conditioning equipment[7]

Refrigerant	GWP (100-year)	ODP	Safety
HCFC-22	1780	0.035	A1
R-410A	2100	0	A1
HFC-134a	1360	0	A1
HFC-32	704	0	A2L
HC-290	<1	0	A3
HFO-1234yf	<1	0	A2L
HFO-1234ze	<1	0	A2L

Table 4. ODP, GWP and safety classification of most common refrigerants and blowing agents used in refrigerating appliances[8]

Refrigerant/Blowing agent	Application	GWP (100-year)	ODP	Safety
HFC-134a	Refrigerant	1360	0	A1
HC-600a	Refrigerant	<1	0	A3
CFC-12 (legacy)	Refrigerant	10’300	0.73	A1
Cyclopentane, isopentane	Blowing agent	<1	0	Unclassified
HFC-245fa	Blowing agent	882	0	B1
HCFC-141b	Blowing agent	800	0.069 – 0.102	Unclassified
CFC-11 (legacy)	Blowing agent	5160	1	A1

[6] UNEP Ozone Secretariat, “2018 RTOC Assessment report”, available at https://ozone.unep.org/sites/default/files/2019-04/RTOC-assessment-report-2018_0.pdf, Table 2-1

[7] UNEP Ozone Secretariat. “2018 RTOC Assessment report”, available at https://ozone.unep.org/sites/default/files/2019-04/RTOC-assessment-report-2018_0.pdf, Table 2.I-1 and Table 2.I-2. Differences may exist from the figures used for reporting according to the Kigali amendment to the Montreal protocol, which uses GWP data from the IPCC AR4.

[8] See Footnote 7, complemented with data from World Meteorological Association, “Scientific Assessment of Ozone depletion 2018”, available at https://ozone.unep.org/sites/default/files/2019-05/SAP-2018-Assessment-report.pdf, Appendix A

Table 5. Safety classification of refrigerants according to ISO 817:2014 and ASHRAE 34[9]

Safety Group

Increasing flammability ↑		
Higher flammability	A3	B3
Lower flammability	A2 A2L*	B2 B2L*
No flame propagation	A1	B1
	Lower toxicity	**Higher toxicity**

Increasing toxicity →

* A2L and B2L are lower flammability refrigerants with a maximum burning velocity of ≤ 3.9 in./s (10 cm/s)

In addition to the safety classification of refrigerants in its intended operational form, the assessment should consider potential decomposition into corrosive and/or toxic products during operation. There are potential concerns regarding the decomposition by-products of hydrofluoroolefin (HFO) refrigerants, although more detailed studies are required to determine the actual impact.[10]

The assessment criteria of potential vendors must ensure that their technicians have received adequate training to handle such equipment.[11] Some aspects that are relevant for the setup and maintenance of cooling equipment include:

(a) Reaction of refrigerants with lubricants in the system.
(b) Flammability of hydrocarbon refrigerants.
(c) Gas recovery equipment adequacy for flammable refrigerants.
(d) Appropriate refrigerant charge (for air conditioners and commercial refrigeration).

[9] ASHRAE, "Factsheet: Update on New Refrigerants Designations and Safety Classifications", available at http://www.ashrae.org/file%20library/technical%20resources/refrigeration/factsheet_ashrae_english_20200424.pdf

[10] UNEP Ozone Secretariat. "2018 RTOC Assessment report", available at https://ozone.unep.org/sites/default/files/2019-04/RTOC-assessment-report-2018_0.pdf, p.14

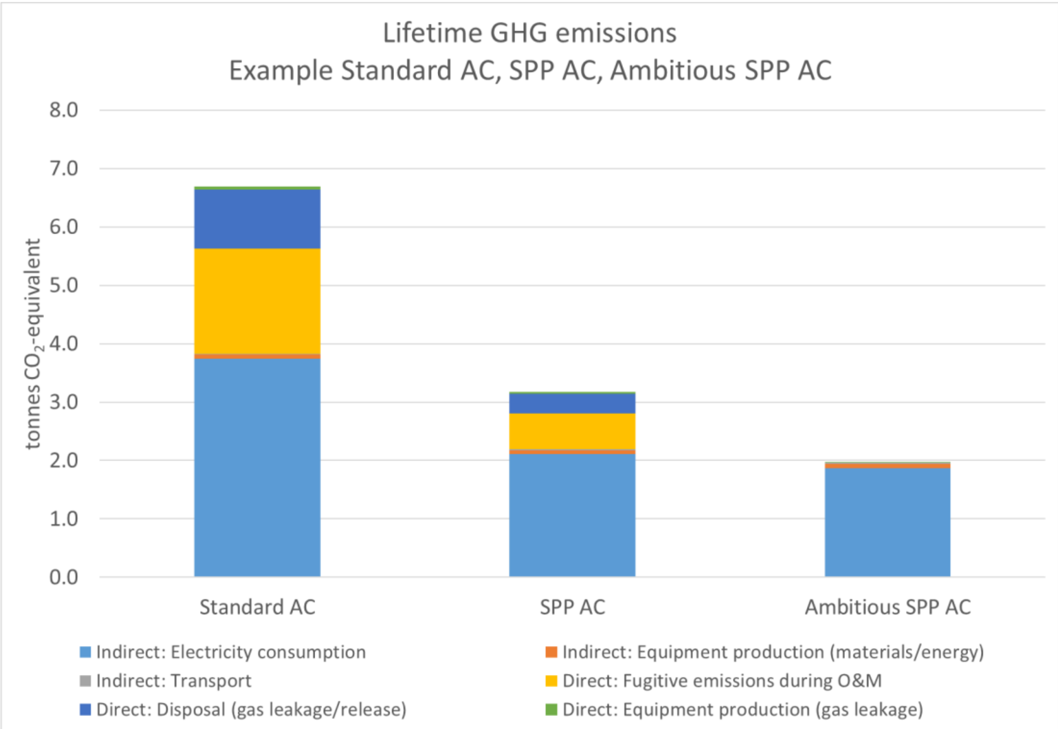
[11] Certifications and training requirements for service technicians vary from country to country. Some examples of training specific to the handling of HC or natural refrigerants are those provided by Proklima or RSES (Refrigeration Service Engineers Society). Information available at https://www.green-cooling-initiative.org/cool-training/ and https://www.rses.org/hydrocarbons.aspx

2.1.3 Indirect greenhouse gas emissions

Cooling and lighting equipment are indirectly responsible for greenhouse gas emissions (GHG) during their lifetime, which includes the production, use and disposal phases. The largest contributor to indirect GHG emissions corresponds to the electricity consumed by the equipment and the GHG-intensity[12] of the electricity supply (e.g., an average coal-fired power plant will have higher emissions per kilowatt hour than the same capacity combined cycle gas turbine power plant). Indirect GHG emissions "embedded" in the product are due to the fuel combustion from production and transport of the equipment and its raw and processed material inputs.

Figure 1 shows the relative weight of the various GHG emissions sources for two sample units: a standard air conditioner (using R-410A) and a more environmentally friendly SPP-compatible air conditioner (using HFC-32 and higher efficiency components). The parameters defining the two sample units are indicated in Table 6. These parameters are intended for illustration purposes and may vary substantially depending on the electricity emission factor, equipment maintenance and disposal practices, hours of operation, and other factors.

Figure 1. Sample lifetime GHG emissions for standard air conditioner and SPP air conditioner



[12] International Energy Agency (IEA), "Global Energy & CO_2 Status Report 2019", available at www.iea.org/reports/global-energy-co2-status-report-2019/emissions

Table 6. Parameters used to estimate sample lifetime GHG emissions of a 3.5 kW air conditioner

	Standard R-410A	SPP model[13] HFC-32	Ambitious SPP model HC-290
Efficiency[14]	4 CSPF (fixed speed)	7.1 CSPF	8 CSPF
Electricity emission factor[15]	0.34 kg CO_2/kWh electricity		
Refrigerant quantity per unit	1 kg		0.4 kg
AC lifetime[16]	17.2 years		
Leakage rate during operation and maintenance (O&M) p.a.[17]	5%		
Remaining refrigerant charge at disposal[18]	80%		
Refrigerant recovered at disposal[19]	40%		

2.1.4 Hazardous substances

Cooling and lighting equipment may contain hazardous materials, such as lubricating oils in the compressor, mercury in fluorescent lighting or other heavy metals in LED lighting. These substances can cause environmental damage and have adverse health impacts if they are leaked or disposed of in an improper way. These impacts mostly occur at the end of the equipment's lifetime.

The European standards for treatment and recycling of electrical and electronic waste and for monitoring the processing companies (WEEELABEX)[20] and the CENELEC EN 50625 standard series provide detailed guidelines/norms for the collection and treatment of electric and

[13] HFC-32 is a medium-GWP HFC. An ambitious SPP programme may target a low-GWP refrigerant, such as HC-290, thereby reducing the direct emissions related to refrigerant leakage.
[14] Cooling seasonal performance factor (CSPF) is an energy efficiency metric for air conditioners defined by ISO 16358. The U4E model regulation guidelines for air conditioners uses this metric as the basis to define MEPS threshold and energy labels.
[15] IEA, "Global Energy & CO2 Status Report 2019", Average worldwide electricity emission factor 2019. Available at www.iea.org/reports/global-energy-co2-status-report-2019
[16] Forti V., Baldé C.P., Kuehr R. (2018), "E-waste Statistics: Guidelines on Classifications, Reporting and Indicators", second edition. Median lifetime value household AC fixed installation.
[17] Intergovernmental Panel on Climate Change (IPCC), "2006 IPCC Guidelines for National Greenhouse Gas Inventories, Chapter 7, Emissions of Fluorinated Substitutes for Ozone Depleting Substances", available at www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/3_Volume3/V3_7_Ch7_ODS_Substitutes.pdf, Table 7.9. Mean value for residential and commercial AC.
[18] IPCC, "2006 Guidelines for GHG Inventories", (see Footnote 17), Table 7.9. Higher threshold for stand-alone commercial applications. Assumes equipment contains refrigerant at end-of-life.
[19] IPCC, "2006 Guidelines for GHG Inventories", (see Footnote 17), Table 7.9. Assumes average recovery collection scheme. It could be as low as 0, if refrigerant is discharged uncontrolled to the atmosphere.
[20] WEEELABEX treatment and re-use operators' documents, available at www.weeelabex.org/documents/treatment-operator/

electronic waste. These documents, for example, indicate which portions of the waste are considered hazardous waste and good practices to avoid its uncontrolled release, etc.

International treaties, such as the Stockholm Convention on Persistent Organic Pollutants and the Minamata Convention on mercury provide an overarching international regulatory framework designed to protect human health and the environment from hazardous substances.

2.1.5 Waste minimisation

At the end of the product life, the non-hazardous components should be reused or recycled when possible, to avoid excessive waste. An intelligent product design can enable a high share of equipment reuse and recycling, which increases resource efficiency and minimises the environmental impact of disposal.

For example, some LED luminaires are constructed with fixed LED modules that make them difficult to be replaced during their operational phase, requiring the purchase of a new complete luminaire once the LED chips reach the end of their operational life. Air conditioning equipment should allow easy access to the various parts that require maintenance, such as filters, heat exchangers, compressors, etc.

2.1.6 Light pollution

Street lighting can cause a loss of star visibility due to upward light output from unshielded luminaires and reflection from the ground. It can also disrupt the behaviour of nocturnal species, with potentially adverse effects on biodiversity. These negative effects may be mitigated by specifying strict photometric requirements for the luminaires, reducing light trespass and upward lighting, and with the application of dimming controls during certain hours.

2.2 Social considerations

An SPP project's social aspects may be classified into potential negative impacts (risks) and potential positive impacts (benefits) for society. The vendor is a primary driver of the social risks, as it is responsible for the health and safety of the technicians installing the products (if this service is included as part of the procurement process). SPP can also promote solutions that address challenges particular to vulnerable communities, such as including under-employed minorities in the vendor workforce requirements.

2.2.1 Effect of lighting and cooling on people

Lighting and air conditioning can have substantial positive effects on people. For example, thermal comfort is positively related to workplace productivity, which can decrease by up to 35 per cent in warm environments.[21] [22]For its part, refrigeration has been instrumental in the development of modern food supply chains, which helps to reduce the amount of food loss and waste.[23]

Similarly, road and street lighting are highly connected to safety and has been proven to reduce traffic accidents and crime rates[24] [25] [26]. Moreover, LED technology provides better colour rendering index (CRI) than traditional lighting sources and it is available in multiple correlated colour temperatures (CCT), enabling a better lighting experience in street lighting applications. The evaluation of potential negative social impact must also be integrated in the public procurement process. Aspects such as stroboscopic effects can have substantial impact in lighting applications. The proposed technical specifications in Section 6 and the U4E technology guidelines [27] [28] [29] contain further details on these and other design criteria.

On the other hand, poor lighting design and products can result in visual discomfort and even negatively affect the safety of risky activities such as driving. Hence an SPP programme must incorporate lighting design considerations used in standard projects.

A public lighting programme crafted to address poorly lit areas with high traffic accident and crime rates could act as a catalyst to the demand for these projects. Other characteristics of sustainable lighting and cooling products, such as better light, air quality, or food safety, may be used to increase the acceptance of these products.

In addition to health and safety aspects, street lighting is highly connected to social activities at night, which is particularly important in commercial and tourist areas. Designing a programme that improves the street lighting quality in these areas may, therefore, result in

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[21] R. Kosonena, F. Tan, “Assessment of productivity loss in air-conditioned buildings using PMV index.”, Energy and Buildings Journal, Vol. 36, 2004

[22] Weilin Cui, Guoguang Cao, Jung Ho Park, Qin Ouyang, Yingxin Zhu, “Influence of indoor air temperature on human thermal comfort, motivation and performance. ” Building and Environment Journal, Vol. 68, 2013.

[23] Food and Agriculture Organization (FAO), “The State of Food and agriculture 2019”, available at www.fao.org/3/ca6030en/ca6030en.pdf

[24] Brandon C. Welsh, David P. Farrington, “Effects of Improved Street Lighting on Crime.”, Campbell Systematic Reviews 2008:13

[25] University of Chicago Crime Lab New York, “Impact of Street Lighting on Crime in New York City Public Housing.”, 2017

[26] Jacketta, Frith, “Quantifying the Impact of Road Lighting on Road Safety—A New Zealand Study.”. International Association of Traffic and Safety Sciences, 2012

[27] UNEP U4E, “Accelerating the Global Adoption of Energy-efficient Lighting”, U4E policy guide series, available at https://united4efficiency.org/resources/accelerating-global-adoption-energy-efficient-lighting/

[28] UNEP U4E, “Accelerating the Global Adoption of Energy-efficient and Climate-friendly Air Conditioners”, U4E policy guide series, available at https://united4efficiency.org/resources/accelerating-global-adoption-energy-efficient-air-conditioners/

[29] UNEP U4E, “Accelerating the Global Adoption of Climate-friendly and Energy-efficient refrigerators”, U4E policy guide series, available at https://united4efficiency.org/resources/accelerating-global-adoption-energy-efficient-climate-friendly-refrigerators/

an appetite by the public authorities for these projects as a way to enhance business activity, and consequentially increase tax revenue. Integration of street lighting with other initiatives, such as the installation of crime-prevention surveillance systems, public Wi-Fi, etc. can also be key to a programme's success.

2.2.2 Work rights of vendor and product manufacturer employees

In the drive towards lower costs dictated by competition, companies look at ways to reduce their internal costs. These activities may result in violations of worker rights, such as poor occupational health and safety, anti-union efforts, child labour and restrictions on collective bargaining etc.

The International Labour Organization (ILO) is a UN agency which promotes social justice and internationally recognised human and labour rights. The organisation sets labour standards, develops policies and devises programs promoting decent working conditions in collaboration with governments, employers and workers in its 187 member states. The ILO's international labour standards are broadly aimed at ensuring accessible, productive, and sustainable work worldwide in conditions of freedom, equity, security and dignity. There is a total of 189 conventions and treaties, of which eight are classified as Fundamental Conventions and are designed to protect the four principles of the 1998 Declaration on Fundamental Principles and Rights at Work, which require:

(a) Freedom of association and the effective recognition of the right to collective bargaining.
(b) The elimination of all forms of forced or compulsory labour.
(c) The effective abolition of child labour.
(d) The elimination of discrimination in respect of employment and occupation. The term discrimination includes any distinction, exclusion or preference made on the basis of race, colour, sex, religion, political opinion, national extraction or social origin.

In addition to the Fundamental Conventions, the ILO Governing Body has designated another four Conventions as governance (or priority) instruments. ILO encourages member states to ratify them because of their importance for the functioning of the international labour standards system.

2.3 Economic considerations

Public entities' limited financial resources, combined with the regulations that govern expenditure, mean that traditionally there has been a focus on lowest-cost purchases. This approach usually results in inefficiencies which cause a long-term negative economic impact on the public finances.

Most governments have perceived these unintended consequences, and procurement regulations allow for evaluation modalities based on price plus technical quality, or even life cycle cost (LCC) assessments. The LCC assessment is particularly relevant for lighting and air conditioning projects, as the vast portion of the lifecycle costs for this infrastructure occurs during its operational phase.

The economic analysis section of this Toolkit complements the U4E market and impact assessment guidance document[30] and provides a tool to assess the expected LCC of specific public procurement projects. For simplicity and transparency, the analysis only includes immediately quantifiable effects, such as initial costs, energy costs, and maintenance costs. The economic models also estimate externalities such as GHG emissions, electrical energy and demand, and work hours, each of which can be assigned monetary values.

Finally, the main drivers of the economic considerations are the product characteristics, and the delivery model, as they determine the profitability for the organisation and the general public.

2.3.1 Budget implications

At its core, the public sector exists to provide a range of services to its citizens, such as education, public safety, water and sanitation, healthcare, defence, and so forth. To deliver public services, organisations avail of limited expenditure budgets. The processes to perform these activities are tightly regulated. Budget expenditures are usually classified into:

(a) Capital expenses (CapEx) dedicated to investments in assets, and
(b) Operational expenses (OpEx) dedicated to recurrent expenditures, such as salaries of government employees, operation & maintenance (O&M) of the infrastructure, electricity bills, etc.

Implementing a sound SPP programme results in lower OpEx costs by reducing energy consumption and, typically, by lowering maintenance costs of the equipment. These advantages usually translate into a price premium, compared to standard products, thereby resulting in higher CapEx requirements.

The correct quantification and monitoring of the financial impact, as well as the alignment of incentives between the different budget lines, is of extreme importance to achieve a successful SPP programme. Alternative delivery models, particularly those that allow for the servitisation of the infrastructure, are a potential mechanism to align incentives. The text box in Figure 2 provides further details on the concept of servitisation.

The nature of public procurement is that it involves discretionary spending of large sums of funds on aggregate on behalf of the government and carries a risk of abuse. The United Nations Commission on International Trade Law (UNCITRAL) has developed a model law on public procurement aimed at assisting states in formulating modern procurement regulations.

[30] UNEP U4E, "Protocols to Conduct Market and Impact Assessments", available at https://united4efficiency.org/resources/protocols-to-conduct-market-and-impact-assessments/

Figure 2. Asset servitisation models explanation[31] [32]

Asset servitisation

Asset servitisation is a business model whereby a service provider offers a client the rights to use an asset, instead of the client acquiring the asset by themselves. In these cases, the asset is purchased, operated, maintained, and financed by the service provider, either with its own resources, debt, or through its sale to a qualified investor. There are multiple variations of this business model, each with its own nuances, but they all share the same overarching financial characteristics.

From a financial point of view, asset servitisation consists of the transfer of liabilities associated with an asset out of the balance sheet of the client, and the accounting of the corresponding regular payments as operational costs. For example, leasing agreements for energy efficiency projects were, under some circumstances, allowed to be considered as operational leases. This meant that the project did not increase the long-term liabilities (i.e., debt) of the public entity and that the lease payments were considered tax-deductible expenses. Since the introduction of more stringent accounting procedures for leases, namely International Financial Reporting Standard (IFRS) 16, this option has been greatly constrained, and those agreements are considered financial leases (i.e., similar treatment as a loan).

Despite the stricter requirements for operational leases, some alternative models have emerged. Commercially, these models are sometimes known as “asset as-a-service”, whether the asset is lighting, cooling or other equipment. They are considered tax-efficient and desirable models from a financial accounting point of view, which have been regulated to avoid a hidden over-indebtedness of institutions.

For example, in the European Union, the transfer of the assets off the balance sheet of the public entity is still a possibility. For this to happen, an Energy Services Company (ESCO) or investor has to be considered the economic owner of the project, which is defined as the party that bears most of the risks and has the right to most of the rewards associated with those assets. The exact conditions for this to happen are exhaustively detailed in a Eurostat guideline document.

In the US, two well-known asset servitisation models that may be applied are the Energy Services Agreement (ESA) and the Managed Energy Services Agreement (MESA). Those models are outlined in Sections 4.4 and 4.5. Other financing models exist in the US thanks to specific legislation that offers tax and other financial advantages to those models, such as Tax-Exempt Lease-Purchase (TELP) agreements for public sector projects, or the Property Assessed Clean Energy (PACE) programme for improvements in private sector assets.

[31] European Commission, Eurostat, Directorate D: Government Finance Statistics (GFS) and Quality, “The Recording of Energy Performance Contracts in Government Accounts”, Guidance Note., 2017. Available at https://ec.europa.eu/eurostat/documents/1015035/7959867/Eurostat-Guidance-Note-Recording-Energy-Perform-Contracts-Gov-Accounts.pdf/

[32] U.S. Department of Energy, Better Buildings initiative, “Efficiency-as-a-service”. Available at https://betterbuildingssolutioncenter.energy.gov/financing-navigator/option/efficiency-a-service

2.3.2 Local job creation

The public sector is an important driver of the economy. For example, the OECD estimates that public purchases of goods and services accounts for 12 per cent of GDP for its member countries.[33] Data collected from the International Monetary Fund (IMF) shows that this figure was 16.7 per cent on average in the Sub-Saharan African and ASEAN countries of this study.[34]

Improving public procurement practices by removing obstacles and boosting the involvement of local small and medium enterprises (SMEs) can maximise their potential for job creation, growth and innovation. Increasing involvement of SMEs in public procurement schemes can, if properly designed, result in higher competition for public contracts, leading to better value for money and efficiencies for contracting authorities.

In addition to the economic benefits, the creation of local jobs can reduce substantial social problems and can also be included in the social considerations. Beyond the economic strain, unemployed individuals, especially the long-term unemployed, often suffer from a greater risk of depression, suicide, alcohol abuse and stigmatisation that stresses self-esteem and personal relationships[35].

3 Barriers to SPP

In the realm of SPP, it is important to understand the characteristics of sustainable projects and the barriers to their implementation.

There are four main groups of barriers identified with SPP programmes:

(a) **Financial barriers**, which relate to the capacity to obtain the required financial resources for the projects. This is particularly important for sustainable products, which usually carry a price premium over standard equipment, but at the same time result in lower operational costs. This situation can result in the creation of split financial incentives between the different public departments that manage the capital expenditure budgets and those that cover the operational expenses related to the assets.

(b) **Awareness barriers**, which relate to the lack of drive or knowledge by public entities to implement SPP programmes. These may have multiple causes, such as priorities on other activities, limited understanding of the benefits, misguided perceptions, etc.

(c) **Capacity barriers**, which relate to the lack of capabilities of the public entities and service providers to develop and implement SPP programmes.

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[33] OECD "Government at a Glance 2019", OECD Publishing, Paris. Available at https://doi.org/10.1787/8ccf5c38-en, p.12

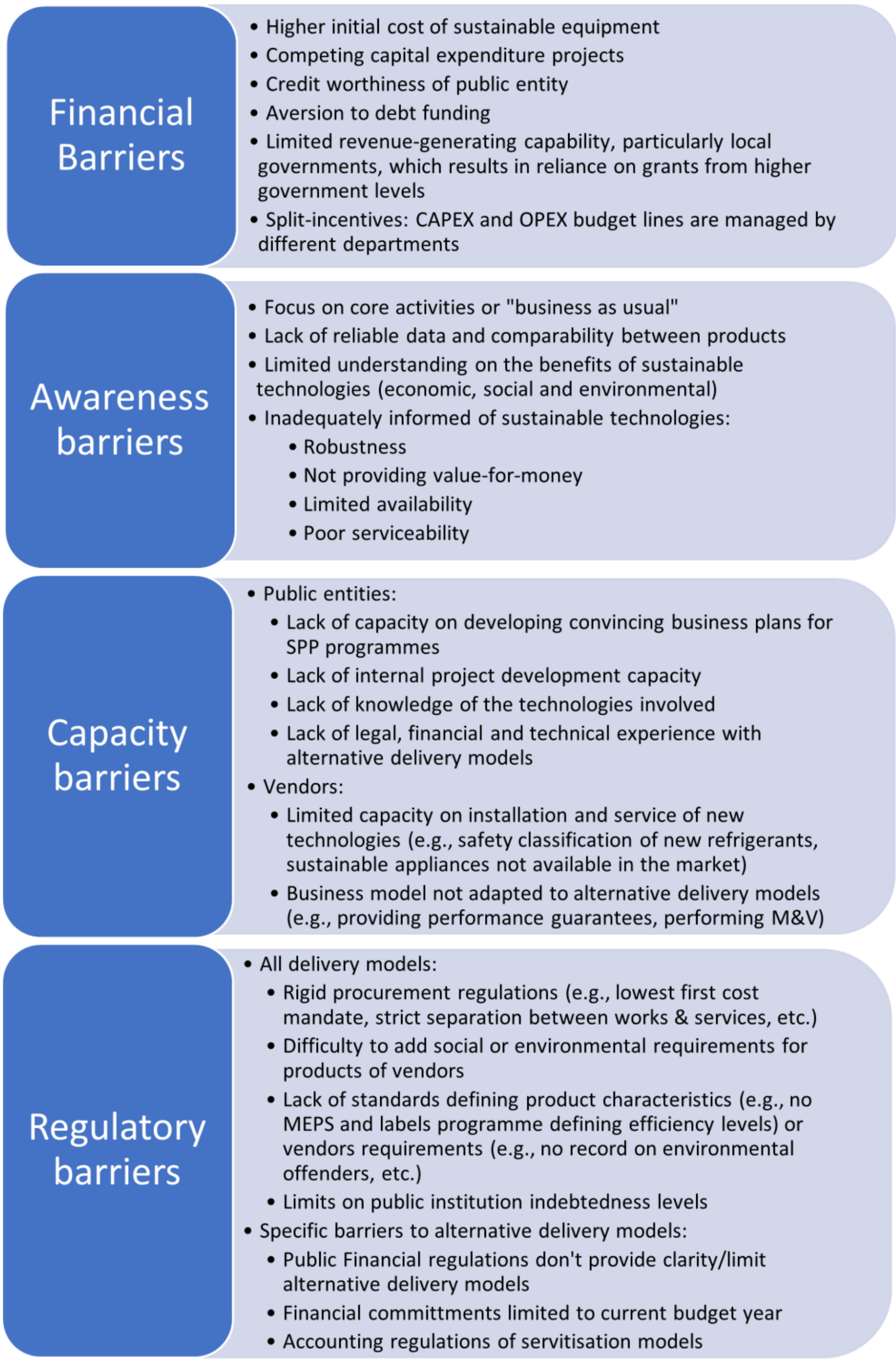
[34] International Monetary Fund (IMF) Government Finance Statistics (GFS) database. Available at http://data.imf.org/GFS

[35] Frey, B., Stutzer, A. "What Can Economists Learn from Happiness Research?", Journal of Economic Literature Vol. XL, June 2002. Available at https://edoc.unibas.ch/20762/1/002205102320161320.pdf

(d) **Regulatory barriers**, which relate to current policies and regulations which may hinder the purchase of sustainable products. These may include restrictive public procurement policies, lack of Minimum Energy Performance Standards (MEPS), lack of social and environmental policies, etc.

A summary of these barriers is shown in Figure 3. This includes typical barriers for each category, not all of which may apply to the specific case being assessed. Sections 3.1 – 3.4 discuss these barriers in more depth.

Figure 3. Summary of SPP barriers



3.1 Financial barriers

Financial barriers can limit the ability of the public institution to obtain adequate funding for implementing SPP.

The management of public finances is centred around the government budget. According to the OECD[36], the budget is a central policy document of government, showing how objectives are prioritised and achieved. Further, the budget is a contract between citizens and the state, showing how resources are raised and allocated to deliver public services.

Most governments contend with rigorous competing needs for funding public initiatives. The decision on which project should be included in the budget is, therefore, a delicate balancing exercise between the various service provision mandates of the public organisations, the constrained funding that derives from a responsible management of public finances, and the reception that these projects will have within the electorate.

Funding procedures outside regular budget cycles, such as public-private partnerships (PPPs), tend to be ill-suited for energy efficiency projects. They are designed for large infrastructure projects and follow complex and costly procurement processes.

The lack of understanding of how, and why, to use SPP as a policy tool results in a strong preference for capital expenditures that satisfy immediate needs at the lowest possible purchase price. This situation is exacerbated in public entities where capital expenditure and operational expenditure responsibilities rest in different departments, or even different ministries. This further strengthens the incentive for the entity responsible for the capital expenditure to procure the lowest cost equipment.

The inherent characteristics of the sustainable products indicate that they usually carry a price premium. As a result, the integration of sustainability criteria in the procurement process often ranks low in budgeting priorities.

Public entities that recognise the benefits of SPP may face other financial barriers, such as limited credit worthiness, that increases the cost of financing the projects through debt facilities.

The issuance of debt tends to be integrated in the budget development process of the public entity. If external funding is deemed to be required for the approved budgets, the treasury departments issue tenders for the provision of such funding, which is granted on the financial status of the entity and not on the merits of the project.

Another common financial barrier, particularly for local governments, is their limited revenue-generating capacity, which restricts their ability to allocate internal funding for SPP projects. Local governments are usually dependent on national government grants or transfers, which

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[36] OECD, Public Governance and Territorial Development Directorate, "Recommendation of the Council on Budgetary Governance", 2015. Available at www.oecd.org/gov/budgeting/Recommendation-of-the-Council-on-Budgetary-Governance.pdf

place several restrictions on the use of those funds and in turn depend on overall country financial and political situation.

A potential strategy to overcome the various financial barriers presented above is the implementation of a cash-flow neutral servitisation model. In these models, the public entity pays a service fee for the use of (sustainable) assets that are owned by a third party, benefits from its use, and retains a buy-out option.

These models avoid the internal competition for capital expenditure budget, do not increase the debt burden of the institution or have a negative impact on the cash flows of the entity, and the service fees are tax-deductible expenses. Despite the advantages, these models have drawbacks, such as a higher lifetime cost and lack of ownership of public service infrastructure, and its application may be restricted by public financial and procurement regulations. Further detail on some of these models is provided in Section 4.

3.2 Awareness barriers

The awareness barriers to the deployment of an SPP programme relate to the lack of drive or knowledge by the public entities to implement them.

For example, service delivery departments of public entities may have not had the opportunity to assess sustainable procurement practices. The inherent motivation of these departments on carrying out their service delivery mandate and focusing on day-to-day activities, possibly while being understaffed, means that the benefits of SPP programmes are unknown.

Moreover, it is commonly the case that early versions of a technology do not meet the market expectations of quality, price, reliability, etc. These early experiences tend to result in a permanent negative perception in the market which drags down the adoption of later versions of the technology that have addressed those shortcomings. Well-known examples of this situation were the early LED lamps (expensive, low lumen output) or CFL lamps (long warm-up times, early failures), which negatively affected their perception in the market.

In order to raise the awareness and increase the commitment of public authorities to SPP projects, it is therefore necessary to present them with accurate and up-to-date information obtained from reliable sources. This effort should also include the higher levels of the government, so they are aware of the economic, social and environmental benefits of an SPP programme. Potential strategies to overcome this barrier include the organisation of peer-to-peer knowledge exchange programmes.

A brief description of the environmental, social and economic benefits of sustainable lighting and cooling products is indicated in Section 2.

3.3 Capacity barriers

The development and implementation of SPP projects are highly specialised tasks, in particular for those following alternative delivery models.

The detailed assessment of social, environmental and economic aspects of these projects tends to fall outside of the technical competences of the various stakeholders. For example, the service delivery departments can usually develop technical specifications for standard projects, but often cannot assess the merits of an SPP programme, develop adequate procurement criteria for them or present a convincing business case that includes LCC assessment during the regular budgeting allocation process.

The vendors face capacity barriers of their own. For example, they may not have been properly trained in the installation and service of air conditioning units with low-GWP refrigerants, which may possess different flammability ratings to traditional refrigerants. Moreover, some of the alternative delivery models presented in this Toolkit require vendors to provide services that may fall beyond their traditional business model. This may be the case for the provision of performance guarantees, development of measurement and verification (M&V) plans, etc.

The design of an SPP programme must address these capacity barriers by providing close support to the various stakeholders. This Toolkit provides a foundation for the capacity building efforts that may be required by public entities and other stakeholders. However, it is recommended that dedicated capacity building workshops are undertaken to fully understand and address the capacity barriers identified above.

As well as increasing the capacities of government officials and other stakeholders, these workshops may provide invaluable feedback on the design of an SPP programme by offering a local perspective. It is often the case that the main interest in SPP programmes from the decision makers stems from the additional benefits that the programmes may provide, for example:

(a) Rollout of air conditioning across government buildings to improve employee motivation.
(b) Integration of air conditioner control systems with a building monitoring system and smart meters to allow the implementation of additional initiatives (e.g., EV charging).
(c) Collaboration with a vocational training centre on new refrigerant installation and servicing.
(d) Improvement of road safety with high-quality street lighting.
(e) Rehabilitation of city centre areas with improved lighting, surveillance and public Wi-Fi systems.
(f) Collaboration with rural electrification programmes to obtain bulk procurement discounts on high quality LED street lighting.
(g) Reduction in grid electricity peak loads.

Feedback gathered during the capacity building workshops may be used to design a tailor-made programme that gets widespread buy-in and facilitates its approval during the annual budgeting process.

3.4 Regulatory barriers

One of the key characteristics of public procurement is that it is controlled by specific regulations, just like any public expenditure. These rules govern the entire procurement process, shaping and limiting the choices available to government officials regarding the equipment to purchase, how to buy it, and from whom to purchase it.

These procurement regulations are defined primarily to ensure appropriate spending of taxpayer funds and to avoid any (perceived or real) irregularity in awarding government contracts.

As such, certain limitations may be imposed on the procurement modalities, contract types, and evaluation criteria used during the procurement. These limitations may result in barriers to the implementation of an SPP programme, for example:

(a) Limitations on the inclusion of social and environmental requirements for products and vendors in the tender documents.
(b) The requirement to follow lowest cost criteria for certain product categories.
(c) The strict separation between procurement categories, which may make it difficult to integrate maintenance and other services with installation works in alternative delivery models. (See Section 4 for more information about works, goods and services).

In addition to the procurement regulatory barriers, public financial management legislation may impose additional restrictions, such as:

(a) Limitations on the amount of debt that public institutions (especially local governments) can have in their accounts.
(b) The accounting regulations that govern the treatment of off-balance sheet financing.
(c) Constraints on entering into financial obligations beyond the current budget period (such as those stemming from alternative delivery models).
(d) Constraints on the recognition of monetary savings generated by SPP procurement, which may disqualify alternative delivery models.

Finally, there are other regulatory barriers unrelated to the public financial management that may affect the implementation of an SPP programme, such as the lack of technical regulations defining equipment efficiency (for instance MEPS and labels) or absence of a registry of vendors with environmental, labour or governance offences, etc.

The purchase of energy-efficient equipment first requires an objective definition of energy efficiency (and acceptable refrigerant requirements for applicable cooling products) and an adequate testing standard that defines the procedures to measure equipment performance and consumption. If a country lacks a well-functioning MEPS and labels programme, the task to define energy efficiency levels for SPP activities is substantially weakened. Similarly, an SPP programme that excludes vendors with previous environmental, social or governance sanctions relies on the availability of official records providing that information.

4 Economic Analysis of Delivery Models

The procurement of sustainable products usually carries a price premium due to the higher quality or special characteristics of the equipment. Such added features may be at odds with the traditional focus on lowest first cost of public procurement processes, however, the long-term benefits should be clearly preferable.

In this section, various delivery models are presented, ranging from a standard project development by the public entity, with or without financing, to alternative delivery models. The presentation of alternative delivery models showcases their advantages compared to traditional procurement options. Advantages range from a transfer of the performance risk to an external party to a variety of financial and accounting benefits.

As the primary focus is usually on simply fulfilling a desired service, such as cooling a room or illuminating a location, the financial and accounting considerations of energy are often overlooked. Delivery models that result in the servitisation of the assets allow a reduced debt burden and tax liability for the public entity and facilitate the investment as the project does not have to compete for CapEx in the budgeting process. These models, however, are subject to intense scrutiny by public finance oversight bodies and require a transparent and constructive dialogue to ensure a successful outcome.

Apart from the regulations governing the financial treatment of the project, the purchase of sustainable equipment must be performed according to applicable procurement regulations. The reader is advised to distil the key features of each delivery model and apply them as appropriate. Particular attention should be paid to identifying gaps in the legislation that hamper implementation, and to engaging with finance departments and oversight bodies to consider potential improvements. Gaps identified may be addressed through updated regulations, or guidance documents that further clarify the conditions for the delivery models that allow the servitisation of assets. The Eurostat guidance document is a good example of clarification provided to procurement practitioners on the accounting of energy services contracting. It defines the conditions for the ESCO to be considered the economic owner of the asset, i.e., allowing a servitisation model, the various financial scenarios, and accounting records that must be kept.

The procurement regulations usually define categories under which various purchases are classified. Most regulations include the following categories (defined by the local procurement authority):

(a) **Public Works:** Handling infrastructure, buildings, outdoor lighting, etc. In this category, public entities outsource the entire construction of the infrastructure.
(b) **Goods:** The purchase, lease or rental of equipment. Public entities possessing internal engineering and construction capabilities may opt for this route by purchasing the equipment and performing the installation using their own personnel.

(c) **Services:** The provision of services such as consulting, equipment maintenance, cleaning, etc. Alternative delivery models such as ESCO Energy Services Agreements (ESAs) or Managed Energy Services Agreements (MESAs) may also fall into this category.

The contracting modalities determine the process required by the regulation to purchase the various categories. These may include open bidding, limited bidding, competitive quotations, and, in more modern regulations, e-purchasing, through an e-catalogue.

Each contracting modality may have different evaluation methods, but may include the following:

(a) Price-only.
(b) Price, once minimum technical criteria are met.
(c) Best-value, which allows the procuring agency to define a range of quantitative criteria, including price.
(d) LCC assessment, where the evaluation includes the construction of systems, operation and maintenance, the cost of capital, and the cost of disposal and remediation of the infrastructure.

This Toolkit presents a set LCC assessments for the two sample projects described below. The objective is to facilitate the understanding of the various models and illustrate the long-term economic benefits of sustainable equipment. These sample projects will be assessed according to the delivery models presented in the Sections 4.1 – 4.5.

Sample Project 1: Street lighting replacement

The Department of Transportation is considering the transition to LED lighting in a city with 250,000 streetlights and 3.5 million inhabitants. The current stock is composed of a variety of high-pressure sodium (HPS) and high-pressure mercury vapour (HPMV) light sources, as indicated in Table 7. A graphical example of the various technologies is shown in Figure 4.The existing infrastructure has seven years of estimated remaining lifetime, at which point, it would need to be replaced. This additional cost is clearly visible in the expected cumulative cash flow charts for the various delivery models.

The baseline case is to continue operating the existing equipment. This sample case features a moderate-inflation, moderate-interest rate macroeconomic situation.

The performance of the proposed replacement LED lighting equipment has been based on widely available technology as of January 2021. The rapid advancement of LED lighting technology means that the technical parameters of the replacement project may become obsolete in a few years, providing even more economically favourable results. The SPP project does not consider controls, such as dimming at very low occupancy hours (e.g., 2 AM–5 AM), or remote connection and troubleshooting, which could further enhance the viability of the project.

Table 7. Sample Project 1 settings

GENERAL SETTINGS		
Country	Pakistan	
Electricity cost	0.132	USD/kWh
Maintenance labor cost	4.0	USD/h
Emission factor	453	kg CO2/MWh
Energy & CO2 price escalation rate	3.0%	p.a.
Equipment escalation rate	4.0%	p.a.
Labor escalation rate	4.0%	p.a.
Estimated equipment lifetime (standard of 20 years for street luminaire)	20	years
EXTERNALITIES SETTINGS		
Carbon price	5	USD/CO2t
Capital cost per kW to grid (only generation, may include distribution)	600	USD/kW
Costs of non or poor Occupational Safety & Health	4%	GDP (value added)
Assumed value added by project to raw cost of materials/services	20%	

PROJECT SETTINGS		
Project type	Replacement	
Remaining lifetime existing equipment	7	years (only replacement projects)

BASELINE			SPP PROJECT		
Model	Units		Model	Units	
Street light HPS 125W	100,000		Street light LED 65W	100,000	
Street light HPS 250W	60,000		Street light LED 120W	60,000	
Street light HPMV 200W	50,000		Street light LED 65W	50,000	
Street light HPMV 80W	40,000		Street light LED 36W	40,000	
Daily average operation	10.5	h	Daily average operation	10.5	h

Figure 4. Lighting technologies in Sample Project 1

HPMV lamp	HPS lamp	Street LED luminaire

Sample Project 2: Inaugural procurement of air conditioning equipment

A national government would like to analyse the impact of a potential national policy that would exclusively procure energy-efficient and climate-friendly air conditioners in new installations.

Public entities currently purchase 10,000 split-system air conditioners per year, with a mix of capacities and refrigerants, as indicated in Table 8. This demand is expected to continue, or increase, in the following years. This sample case features a high-inflation, high-interest rate macroeconomic situation.

For ease of reference, the example only considers the purchase of similar types of equipment (split-system air conditioners). The option of installing centralised equipment instead of split units has not been assessed, as it requires facility-specific information. Nonetheless, public procurement entities are advised to consider a range of options, first by reducing thermal loads (passive measures can include use of shading, solar reflective coatings on the building exterior, use of fans, leveraging natural ventilation, improving insulation, etc.) and also considering a range of mechanical cooling options to meet residual cooling needs, as larger central systems may be a more suitable solution.

Table 8. Sample Project 2 settings

GENERAL SETTINGS		
Country	Ghana	
Electricity cost	0.110	USD/kWh
Maintenance labor cost	3.5	USD/h
Emission factor	360	kg CO2/MWh
Energy & CO2 price escalation rate	8.0%	p.a.
Equipment escalation rate	10.0%	p.a.
Labor escalation rate	10.0%	p.a.
Estimated equipment lifetime	15	years
EXTERNALITIES COSTS		
Carbon price	5	USD/CO2t
Capital cost per kW to grid	1000	USD/kW
Costs of non or poor Occupational Safety & Health	4%	GDP (value added)
Assumed value added by project to raw cost of materials/services	20%	
Refrigerant leakage	5%	p.a.
Refrigerant quantity (est)	0.286	kg/kW cooling cap.

PROJECT SETTINGS				
Project type	New installation			
Remaining lifetime existing equipment	5	years (only replacement projects)		
Annual active time	4973	h (weather dependent)		
Equivalent Full Load Hours	2812	h (weather dependent)		
BASELINE			**SPP PROJECT**	
Model	Units		Model	Units
3.5 kW - Non-MEPS new equipment - R410A	4000		3.5 kW - M.Regs Intermediate Eff. - R32	4000
3.5 kW - Non-MEPS new equipment - R22	3000		3.5 kW - M.Regs Intermediate Eff. - R290	3000
5.3 kW - Non-MEPS new equipment - R410A	2000		5.3 kW - M.Regs Intermediate Eff. - R32	2000
5.3 kW - Non-MEPS new equipment - R22	1000		5.3 kW - M.Regs Intermediate Eff. - R290	1000

In addition to the sample results provided in Sections 4.1 – 4.5, an Excel spreadsheet tool containing the LCC assessment methodology for the various models is provided separately[37] to facilitate the assessment of specific cases. The results can be used as supporting documentation of the LCC of products under consideration.

The LCC analysis has been tailored to depict the tangible monetary benefits for the public entity. Additional benefits in the form of reduced GHG emissions and electric demand reduction are also included to estimate the contribution to broader economic development, climate and/or environmental objectives.

A summary of the advantages and disadvantages of each model is indicated in Table 9 and each model is discussed in more detail in Sections 4.1 – 4.5.

[37] Available on the U4E website at https://united4efficiency.org/resources/tools/

Table 9. Delivery models assessment summary for public sector air conditioning and lighting

Model	Advantages	Disadvantages	Assessment
Standard project development – own resources/grant funding	• Keeps public entity in control of infrastructure • Lowest lifetime cost • Easy-to-understand model	• Funding may be limited • Requires technically competent project preparation • Performance risk of not achieving the savings or quality of service stays with the public entity • Competition with other CapEx projects in the annual budget process	• Feasible • Traditional funding from annual budgets
Standard project development – debt funding	• Keeps public entity in control of infrastructure • Lower upfront cost • Easy-to-understand model	• Requires technically competent project preparation • Requires a credit-worthy public entity • Performance risk stays with the public entity • Funding cycles & debt limits for public clients are usually tightly regulated • Competition with other CapEx projects in the annual budget process • Increases long-term liabilities on the balance sheet	• Feasible • Debt funding likely integrated into the budget planning process
ESCO model, performance guarantee – financing the end-client	• Less limited by the technical capability of the public entity • Performance risk transferred to ESCO	• Limited additional benefit for technically competent public entities • Requires continuous monitoring (quarterly/annually) • Higher costs due to M&V process and equipment • Requires credit-worthy public entity • Funding cycles & debt limits for public entities are usually tightly regulated • Increases long-term liabilities on the balance sheet • Requires the presence of ESCOs in the market	• Feasible for public entities with lower project development capacity

Model	Advantages	Disadvantages	Assessment
ESCO model ESA/shared savings – financing the ESCO	• Less limited by the technical capability of the public entity • Performance risk transferred to ESCO • No upfront cost for the public entity • Potential OpEx funding – the project does not increase long term liabilities in the balance sheet and reduces tax liability (always depending on local accounting regulations and contract structure) • Bundles projects into a single funding recipient – scalable and attractive for financial institutions.	• Requires financially competent project preparation & post-implementation support • Requires sophisticated financial institutions that understand ESCO models. • Requires continuous monitoring (quarterly/annually) • Higher costs due to M&V process and equipment • Operational transfer of public infrastructure to a private company • Lack of familiarity may inhibit consideration of new models • Requires the presence of ESCOs operating under this model in the market	• Feasible • Classic model for public street lighting • Higher complexity for AC projects (measurement of savings complex in split-type equipment)
ESCO model MESA – financing the ESCO	• Less limited by the technical capability of the public entity • Performance risk transferred to ESCO • No upfront cost for the public entity • Transparent pricing structure which translates into an easy-to-understand concept • Bundles projects into a single funding recipient – scalable and attractive for financial institutions • Potential OpEx funding – does not increase long-term liabilities on the balance sheet and reduces tax liability (depends on local accounting regulations and contract structure)	• Requires sophisticated financial institutions that understand the ESCO model • Requires the presence of ESCOs operating under this model in the market • Public clients – involved department must be willing to transfer the operation of critical infrastructure to a private company • Public clients - negative perception of new models by the general public	• Feasible • Requires a very technically competent ESCO

4.1 Standard project development – own resources/grant funding

The public sector's traditional project development model separates the technical process (managed by the service delivery department) and the funding process (managed by the finance department). Although budgeting processes vary by government, in general, the public entity develops a preliminary technical design and cost estimation, which is then proposed as part of the annual budget.

If the project is approved for funding, the public entity starts the procurement process according to established regulations. If the regulations call for a tender process, the public entity develops the tender documents, and companies present their proposals. For non-standard projects, such as street lighting, this process requires greater technical competence in developing terms of reference and analysing vendor proposals.

In grant funding cases, specific criteria may be included by outside donors or central government agencies to achieve broader objectives than those typically considered by the recipient (e.g., a local government), and these additions may be unfamiliar and cumbersome.

This internal-budget funding option and grant funding option are shown graphically in Figure 5 and Figure 6 respectively. For simplicity, the diagrams display a situation where the vendor provides a turnkey project (installation fully functional), as opposed to a public entity purchasing equipment and performing the installation.

Figure 5. Standard project development – own resources

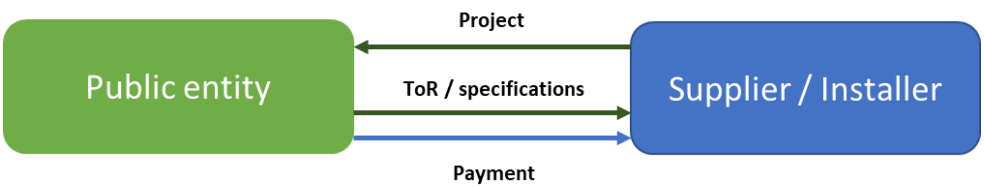


Figure 6. Standard project development – grant funding

This model is the simplest. It results in the lowest LCC of all models because of the lack of debt financing or M&V costs. This model has the disadvantage of requiring full availability of funds to cover the cost by its completion.

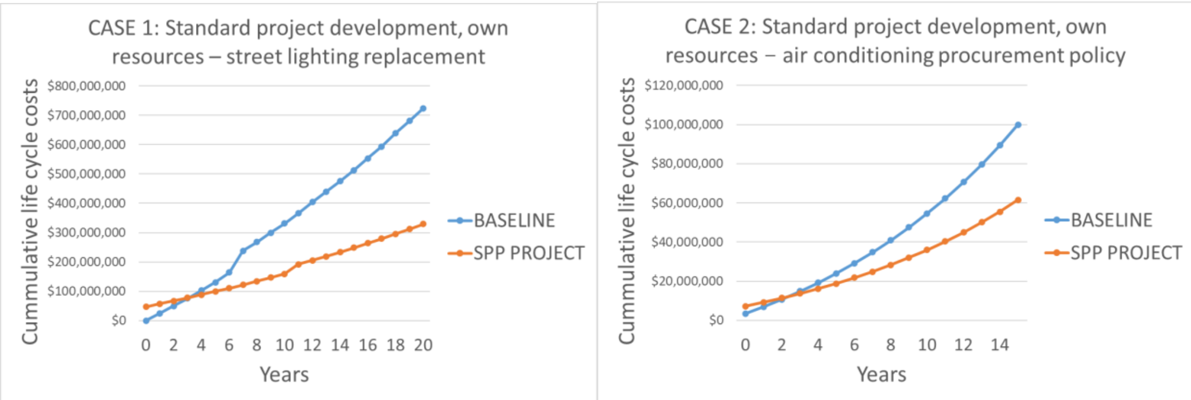
The results for the lighting and air conditioning sample projects are shown in Table 10 and Figure 7.

Table 10. Results of own resources model – sample lighting project and AC procurement policy

CASE 1: Standard project development, own resources – street lighting replacement			
RESULTS	**BASELINE**	**SPP PROJECT**	
Project costs	$0	$47,500,000	
Initial investment	$0	$47,500,000	
Lifetime costs (excluding externalities)	$723,962,134	$329,326,724	
Lifetime externalities costs	$40,084,045	$15,766,025	
Average annual savings in first 10 years SPP PROJECT vs BASELINE		$21,917,601	p.a.
IRR SPP PROJECT vs BASELINE		37.8%	
Simple payback (net positive cummulative cash flow)		3.1	years
Note			
BASELINE and SPP PROJECT financed with own resources			

CASE 2: Standard project development, own resources – air conditioning procurement policy			
RESULTS	**BASELINE**	**SPP PROJECT**	
Project costs	$3,440,000	$7,300,000	
Initial investment	$3,440,000	$7,300,000	
Lifetime costs (excluding externalities)	$99,965,517	$61,489,965	
Lifetime externalities costs	$11,158,616	$6,098,333	
Average annual savings in first 10 years SPP PROJECT vs BASELINE		$2,245,311	p.a.
IRR SPP PROJECT vs BASELINE		47.6%	
Simple payback (net positive cummulative cash flow)		2.4	years
Note			
BASELINE and SPP PROJECT financed with own resources			

Figure 7. Cost evolution of own resources model – sample lighting project and AC procurement policy



The analysis shows the economic benefit for both projects. The lighting replacement would save the public entity close to USD 22 million per year and achieve a simple return on investment of just over three years. The results also consider the regular replacement of the lamps/modules within the luminaire, and the planned replacement of the existing luminaires at Year 7.

The most significant barrier to implementing the project is the high investment cost of over USD 47 million. The remaining delivery models analysed in this section describe different approaches to address the barrier of high initial investment, while showing the trade-off of higher lifetime costs. Unlike the lighting case, the air conditioning procurement policy also requires an initial investment for the purchase of standard equipment since it is assumed that air conditioners were not used previously.

The results show the considerable economic benefit of the more sustainable equipment. The cost of sustainable equipment is USD 11 million, more than twice than the baseline case. However, these higher costs are recovered in just 2.5 years thanks to the equipment's greater efficiency, which yields annual savings of USD 2.6 million.

4.2 Standard project development – financing the end-client

This model is similar to the self-funded option, but the funding is partially obtained through a debt instrument in the form of a loan from a bank or a specialised investment vehicle (e.g., climate change mitigation fund). In large projects (greater than USD 10 million), a dedicated project finance facility may be considered. However, in most cases, the funding is integrated into the annual budgeting process of the public entity. These simple debt instrument and dedicated project finance scheme options are illustrated in Figure 8 and Figure 9 respectively.

Figure 8. Debt financing model

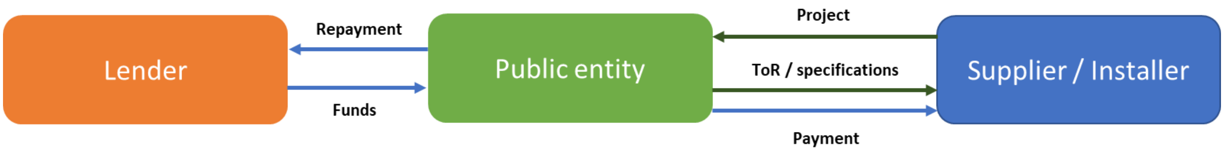
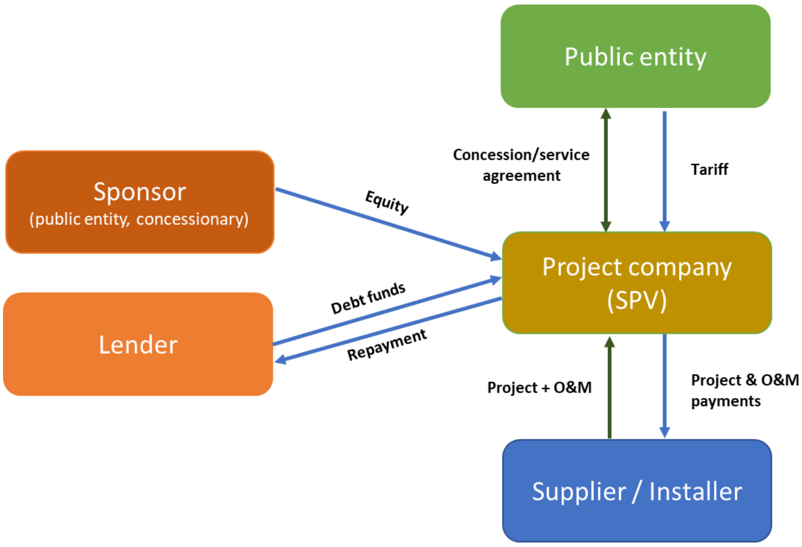


Figure 9. Debt financing model – project finance scheme



The main constraints of this model are the credit worthiness of the public institution and the statutory limits (if any) in the amount of debt that it is allowed. A credit analysis of the end-client is also required, which in non-specialised lenders typically follows the same procedure as a loan for non-energy projects. This neglects the effects that the energy efficiency project will have in the entity's cash flow situation, which, depending on the scope of the project, may indeed have a substantial positive impact. For example, an important part of the budget in municipal entities is dedicated to street lighting, which typically ranges between 5% and 20% of the municipal budget.[38] A well-designed street lighting project may improve the financial situation of a municipality, which would enhance its credit capacity.

[38] The World Bank - Energy Sector Management Assistance Programme (ESMAP), “Proven delivery models for LED public lighting, Synthesis of Six Case Studies”. Available at https://openknowledge.worldbank.org/bitstream/handle/10986/25336/109532-ESM-P152422-PUBLIC-ABSTRACT-SENT-FINALESMAPProvenDeliveryModelsLEDPublicLightingKSopt.pdf

Hybrid funding consists of blending traditional funds at commercial conditions and concessional funding, i.e., at subsidized interest rates, to provide a loan with favourable terms and conditions. In this case, the criteria to provide funds is relaxed compared to a pure grant-funding scheme. Such a mechanism also provides an economic incentive to end-users to take commercial sources of debt by lowering the overall financing costs.

An additional support mechanism that can lower awareness barriers in complex projects is the provision of partial risk guarantees through a dedicated source of grant funding. Under this scheme, a guarantee provider agrees with financial institutions (FIs) which projects are eligible, the percentage of loan that is guaranteed, default protocols, etc. The FI initiates the relevant transactions with borrowers seeking commercial loans and reports those loans to the guarantee provider. If a borrower defaults on a qualifying loan, it triggers the pay-out process from the guarantee scheme.

The guarantee mechanism is also applicable to alternative delivery models. It allows an alignment of incentives between the FI and the guarantee provider, as only a portion of the loans is guaranteed. The FI still assesses the credit worthiness of borrowers. The reader is advised to assess existing or planned support mechanisms from national or international organisations that seek to promote sustainable investments. Multilateral development banks (MDB), development financial institutions (DFI) or cooperation agencies have programmes dedicated to this purpose worldwide.

The results for the lighting and air conditioning sample projects are shown in Table 11 and Figure 10. The analysis has taken a simplified approach, assuming the provision of a dedicated loan for the project.

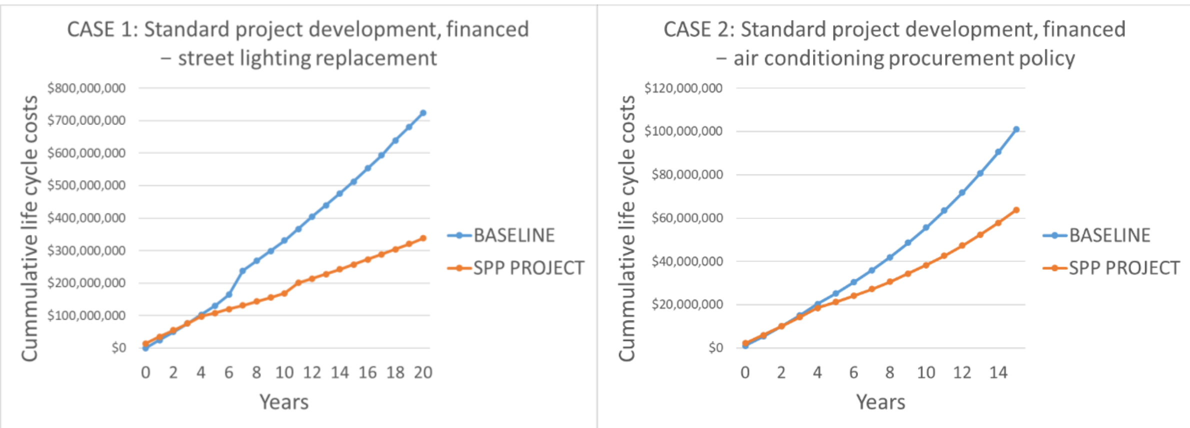
In reality, public entities most likely would integrate this project in its annual budget and debt funding requirements, thereby diluting the funding ratio and financing costs in the overall budget of the entity. The loan term used for the calculation is four years, with an interest rate of 10 per cent, and 70 per cent financing of the total project cost.

Table 11. Results of debt financing model – sample lighting project and AC procurement policy

CASE 1: Standard project development, financed – street lighting replacement			
DELIVERY MODEL SETTINGS			
Loan tenor	4	years	
Interest rate	12.0%		
Loan to project cost ratio	70.0%		
RESULTS	**BASELINE**	**SPP PROJECT**	
Project costs	$0	$47,500,000	
Initial investment	$0	$14,250,000	
Debt increase in balance sheet	$0	$33,250,000	
Lifetime costs (excluding externalities)	$723,962,134	$338,105,525	
Lifetime externalities costs	$40,084,045	$15,766,025	
Average annual savings in first 10 years SPP PROJECT vs BASELINE		$17,714,720	p.a.
IRR SPP PROJECT vs BASELINE		56.6%	
Simple payback (net positive cummulative cash flow)		3.0	years
Note			
BASELINE and SPP PROJECT financed by external FI with loan of same characteristics			

CASE 2: Standard project development, financed – air conditioning procurement policy			
DELIVERY MODEL SETTINGS			
Loan tenor	4	years	
Interest rate	20.0%		
Loan to project cost ratio	70.0%		
RESULTS	**BASELINE**	**SPP PROJECT**	
Project costs	$3,440,000	$7,300,000	
Initial investment	$1,032,000	$2,190,000	
Debt increase in balance sheet	$2,408,000	$5,110,000	
Lifetime costs	$101,074,780	$63,843,925	
Average annual savings in first 10 years SPP PROJECT vs BASELINE		$1,850,641	p.a.
IRR SPP PROJECT vs BASELINE		73.4%	
Simple payback (net positive cummulative cash flow)		1.9	years
Note			
BASELINE and SPP PROJECT financed by external FI with loan of same characteristics			

Figure 10. Cost evolution of debt financing model – sample lighting project and AC procurement policy



The analysis shows the impact of the financing in the overall return, bringing the simple payback of the lighting replacement project down to 3 years due to the higher internal rate of return of the project compared to the financing costs. More importantly, the public entity's capital requirement as the initial investment in the project is considerably reduced to USD 14.25 million.

The debt financing model of the air conditioning sample project presented above has followed a similar approach as in the case of lighting. The main differences are:

(a) High inflation and interest rates dominate the macroeconomic situation in the country.
(b) The baseline scenario also considers the provision of debt for the purchase of the standard equipment. The terms and conditions are the same as in the SPP project.

Despite the high interest rate, the project still achieves an attractive return on the investment and a simple payback of less than two years. The relatively high inflation rate, which results in growing operational savings from lower electricity consumption combined with a solid technical project, delivering substantial efficiency gains are the main reasons for this result.

4.3 ESCO model: Performance guarantee – financing the end-client

This delivery model introduces an energy services company (ESCO). An ESCO is a special service provider that combines procurement of goods, project installation capability and a post-installation service guaranteeing the system's performance, which has a direct impact on its energy consumption. Typically, the ESCO also guarantees the maintenance cost of the equipment. This means that, should the promised energy performance (energy savings) not be achieved, the ESCO would have to financially compensate the public entity for the underperformance.

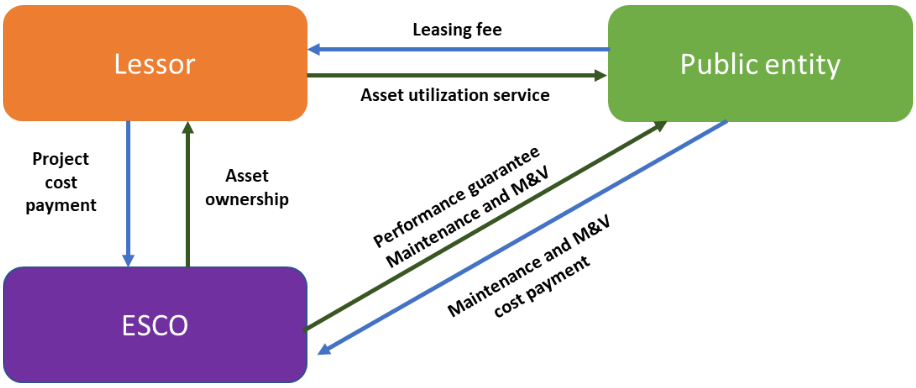
In this model, the public entity purchases the project. Funding may come from own resources, grants or in the form of a loan, similar to the self-developed model. Simultaneously, the technical risk for the end-client is reduced by transferring the responsibility that the project will perform correctly to the ESCO. Penalties are applied to the ESCO should the performance (energy savings) of the project not meet the contractually agreed terms. A special characteristic of the models that demand performance guarantees is that the ESCOs may require a preliminary analysis phase (energy assessment or energy audit) of the existing infrastructure. The need for this phase may depend on the complexity of the project and the level of technical detail available on the existing infrastructure.

In developed ESCO markets, public entities (usually municipalities) may choose this model for large programmes (which often consist of a bundle of smaller projects) as they can issue low-cost debt funding through municipal bonds. A summary of this model is shown in Figure 11.

Figure 11. Performance guarantee model

A variation of this model involves the ESCO selling the project's assets to a leasing company that then enters into a leasing agreement with the public entity. In a financial lease, this structure is similar to a debt provision. The performance guarantee allows the public entity to service the leasing fee, should the savings be lower than contractually agreed. This is structure of this model is summarised in Figure 12.

Figure 12. Performance guarantee model with leasing company financing.



The procurement process for the simplest form of performance guarantee ESCO model presented in Figure 11 has a similar implementation as the standard project development. Still, it requires particular attention to the contractual definition of the performance objectives, the baseline used for comparison, baseline adjustment methods, and M&V activities. Typically, ESCOs build a safety margin into the theoretical savings that reduces the estimated savings guaranteed to the public entity.

The application of a safety margin is, nevertheless, a mitigation measure. The financial performance of the ESCO is still dependent on the technical performance of the project. For this reason, ESCOs usually have personnel dedicated to the constant evaluation of the project's performance. Once the performance guarantee period is over, the ESCO stops these activities, and the performance of the equipment may suffer if the public entity does not continue the regular optimisation activities.

Further, the performance guarantee means that the equipment utilisation and consumption must be measured, usually with additional monitoring equipment. The ESCO personnel must dedicate time to the preparation of regular M&V reports showing the results achieved. All these activities cause an increase in the project installation cost and recurring M&V costs.

The factors described above have been included in the calculation model in this Toolkit to provide a more realistic representation of a project under this model. The calculations assume that the assets must remain in the balance sheet of the public institution. As outlined above, under some legislation and contractual structures, off-balance sheet financing may be possible, which brings additional benefits. The results for the two sample cases are shown in Table 12 and Figure 13.

Table 12. Results of ESCO model, performance guarantee – sample lighting project and AC procurement policy

CASE 1: ESCO model, performance guarantee – street lighting replacement

DELIVERY MODEL SETTINGS		
BASELINE Loan tenor	0	years
BASELINE Interest rate	0%	
BASELINE loan to project cost ratio	0%	
SPP PROJECT contract duration ESCO (same as loan tenor from FI)	5	years
SPP PROJECT interest rate (from FI to public entity)	12%	
SPP PROJECT loan to project cost ratio (from FI to public entity)	70%	
SPP PROJECT M&V annual costs (between 2-5% depending on project size, guarantee type, etc.)	5%	of savings
SPP PROJECT Safety margin on savings ESCO (between 5-20% depending on project & guarantee type)	10%	of savings
SPP PROJECT Expected savings after performance period	90%	of theoretical savings
SPP PROJECT Expected ESCO extra costs on installation (due to monitoring equipment, audits, etc.)	10%	of standard costs

RESULTS	BASELINE	SPP PROJECT	
Project costs	$0	$52,250,000	
Initial investment	$0	$15,675,000	
Debt increase in balance sheet	$0	$36,575,000	
Lifetime costs (excluding externalities)	$723,962,134	$394,059,969	
Lifetime externalities costs			
Guaranteed savings by ESCO in performance guarantee phase		$70,585,282	
Average annual savings in first 10 years SPP PROJECT vs BASELINE		$14,491,370	p.a.
IRR SPP PROJECT vs BASELINE		44%	
Simple payback (net positive cummulative cash flow)		4.4	years

Note

BASELINE and SPP PROJECT financed by external FI to public entity (different settings as there may be different conditions). Model includes costs for Monitoring & Verification of guaranteed savings

CASE 2: ESCO model, performance guarantee – air conditioning procurement policy

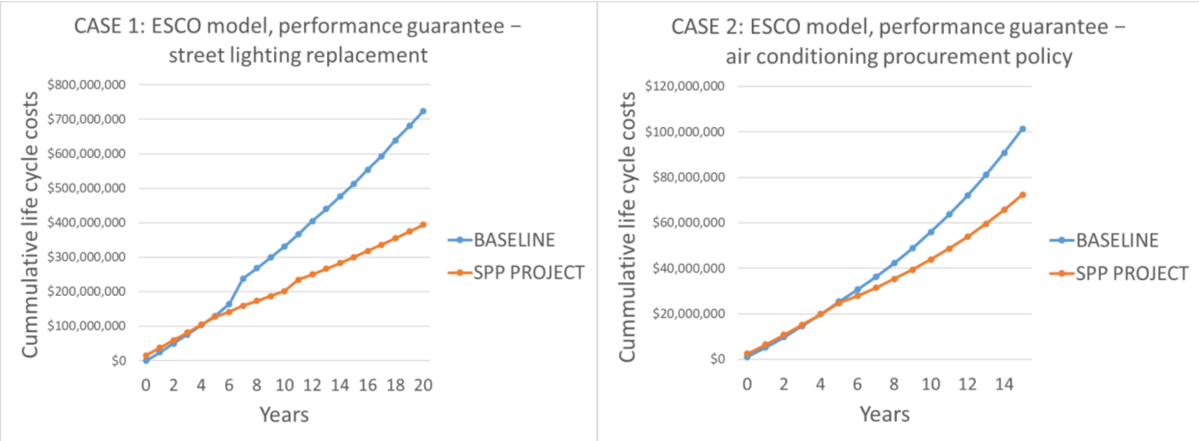
DELIVERY MODEL SETTINGS		
BASELINE Loan tenor	5	years
BASELINE Interest rate	20%	
BASELINE loan to project cost ratio	70%	
SPP PROJECT contract duration ESCO (same as loan tenor from FI)	5	years
SPP PROJECT interest rate (from FI to public entity)	20%	
SPP PROJECT loan to project cost ratio (from FI to public entity)	70%	
SPP PROJECT M&V annual costs (between 2-5% depending on project size, guarantee type, etc.)	5%	of savings
SPP PROJECT Safety margin on savings ESCO (between 5-20% depending on project & guarantee type)	10%	of savings
SPP PROJECT Expected savings after performance period	85%	of theoretical savings
SPP PROJECT Expected ESCO extra costs on installation (due to monitoring equipment, audits, etc.)	15%	of standard costs

RESULTS	BASELINE	SPP PROJECT	
Project costs	$3,440,000	$8,395,000	
Initial investment	$1,032,000	$2,518,500	
Debt increase in balance sheet	$2,408,000	$5,876,500	
Lifetime costs	$101,385,353	$72,355,044	
Guaranteed savings by ESCO in performance guarantee phase		$8,141,914	
Average annual savings in first 10 years SPP PROJECT vs BASELINE		$1,361,673	p.a.
IRR SPP PROJECT vs BASELINE		44%	
Simple payback (net positive cummulative cash flow)		3.9	years

Note

BASELINE and SPP PROJECT financed by external FI to public entity (different settings as there may be different conditions). Model includes costs for Monitoring & Verification of guaranteed savings

Figure 13. Cost evolution of performance guarantee model – sample lighting project and AC procurement policy



The baseline scenario for the lighting project consists of the continuation of current activities, hence, there is no initial investment cost and no need for debt funding. In the SPP project case, the installation costs are higher than in previous models, due to the additional costs for M&V, both at installation and during the operation of the project. As a result, the return on the investment is lower, and the payback period longer.

The results of the performance guarantee ESCO model for the sample case assessing the impact of establishing an air conditioning SPP policy show that the higher investment and operational costs result in a longer payback period and lower return on the investment. The main benefit compared to the standard development model that includes financing is that the savings obtained by the public entity are guaranteed by the ESCO.

4.4 ESCO model: ESA/shared-savings – financing the ESCO

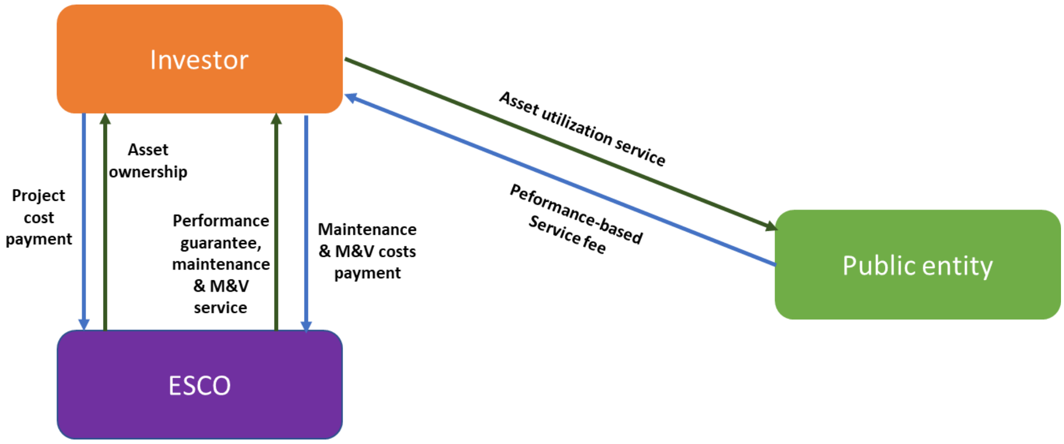
In the energy services agreement (ESA) model, the ESCO implements the project, guarantees the performance of the installation and either invests directly in the project or sells it to an investor (usually a specialised financial institution). In the case that the ESCO invests in the project, it may opt to finance it through a loan.

The key difference between the performance contracting and the ESA model is that in this case the public institution does not invest in the project, and the payments made by the public entity are linked to the actual performance of the project.

As in the case of the performance contracting model, the ESCOs may require a preliminary analysis phase (energy assessment or energy audit) of the existing infrastructure. The need for this phase may depend on the complexity of the project and the level of technical detail available on the existing infrastructure.

Figure 14 shows the structure of an ESA model where the ESCO sells the assets to an investor, which then has an energy service contract with the public entity. Maintenance of the facilities is also typically included in the scope of the ESCO for it to be able to provide the performance guarantee. In the case that the ESCO retains the asset ownership, the roles of the ESCO and the investor are merged. This is one possible structure for ESA agreements –other options are also available, usually in the form of "asset as-a-service" directly offered by the ESCO.

Figure 14. ESA model with ESCO selling assets to investor



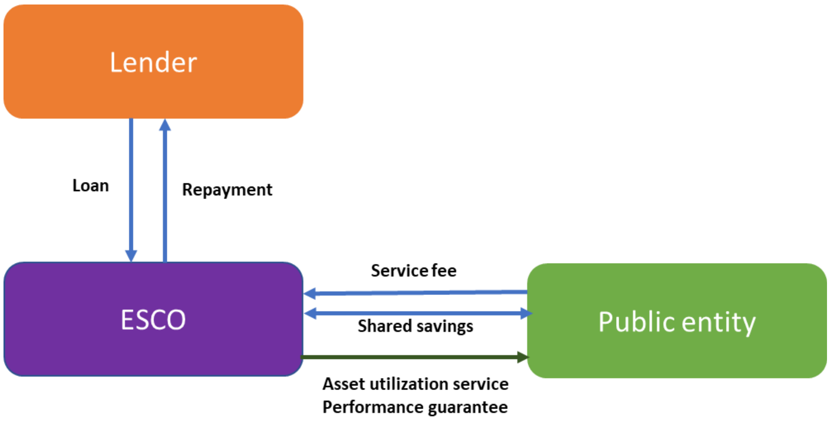
The ESA model has several advantages. It substantially reduces the risk for the end-client and does not require any upfront capital. It also results in net positive cash-flows for the public entity from day one. Moreover, the service fees to the ESCO are considered as operating expenses under most accounting regulations, resulting in a zero impact on their balance sheet and a reduced tax base compared to the case where the end-client performed the investment by themselves.

In the case of financed projects, the credit assessment is shifted to the ESCO, instead of the public entity, which may benefit entities with low credit ratings. From a financial institution perspective, it allows the reduction of transaction costs by packaging multiple projects from one ESCO into a single loan.

The main disadvantage of this model is that it increases the complexity of the programme management, as payments to be made by the public entity depend on the level of savings achieved, which are summarised in M&V reports. In less-developed markets, ESCOs may not offer this model due to the inherent risk for them and inexperience with actual project implementation and verification of savings. This model also means that the public entity relinquishes ownership of assets that may be used to provide a public service. This characteristic may be unfavourably perceived by some entities.

A widely known version of ESA agreements is the shared-savings model. In these agreements, the savings achieved through reduced energy consumption and maintenance costs are shared on a predetermined basis between the end-client and the ESCO/investor. Figure 15 shows the structure of the shared-savings model, where the ESCO retains ownership of the assets and obtains a loan from a lender to cover part of the asset costs.

Figure 15. ESA model, shared savings arrangement, with ESCO retaining ownership of assets, taking a loan



For operational reasons, the public entity usually pays a regular fee for the expected share of savings belonging to the ESCO. At predetermined intervals (quarterly/annually), the actual performance of the project is determined through an M&V report. A reconciliation of the shared savings corresponding to each party is performed and the corresponding payment made, either by the ESCO if the agreed savings were not achieved or the public entity if they were exceeded.

It is essential to agree with the client, and correctly formulate in the contract, the methodology that the M&V report will use, as poorly drafted agreements result in lengthy discussions about the split of savings.

A disadvantage of the shared-savings mechanism is that end-clients tend to associate this model with a whole-facility M&V method, which would determine the savings using the electricity consumption recorded at the main meter. This creates a substantial barrier in projects with complex interacting measures (e.g., energy efficiency in buildings).

Despite the economic advantages, this model can also result in end-clients perceiving that more energy savings result in higher costs due to the correlation between the payments to the ESCO and the amount of savings.

The financial model developed as part of this Toolkit has considered the shared-savings modality, as it is the most widely known. The results for the two sample projects are shown in Table 13 and Figure 16.

Table 13. Results of ESA, shared savings model – sample lighting project and AC procurement policy

CASE 1: ESCO model, ESA/shared-savings – street lighting replacement

DELIVERY MODEL SETTINGS		
BASELINE Loan tenor	0	years
BASELINE Interest rate	0.0%	
BASELINE loan to project cost ratio	0.0%	
SPP PROJECT contract duration ESCO (same as loan tenor from FI)	7	years
SPP PROJECT share of savings provided to public entity during contract duration	20.0%	
SPP PROJECT interest rate (from FI to ESCO)	12.0%	
SPP PROJECT loan to project cost ratio (from FI to ESCO)	70%	
SPP PROJECT M&V annual costs (between 2-5% depending on project size, guarantee type, etc.)	5%	of savings
SPP PROJECT Safety margin on savings ESCO (between 5-15% depending on project & guarantee type)	5%	of savings
SPP PROJECT Expected savings after performance period	90%	of theoretical savings
SPP PROJECT Expected ESCO extra costs on installation (due to monitoring equipment, audits, etc.)	10%	of standard costs
SPP PROJECT Expected ESCO return on its own equity (for non-100% financed projects)	20%	

RESULTS	BASELINE	SPP PROJECT	
Project costs	$0	$52,250,000	
Initial investment	$0	$0	
Debt increase in balance sheet	$0	$0	
Lifetime costs (excluding externalities)	$723,962,134	$411,162,206	
Lifetime externalities costs			
IRR ESCO (model not attractive for ESCO if less than expected return)		23%	
Expected absolute profitability ESCO		$21,105,962	
ESCO gross margin		40%	
IRR SPP PROJECT vs BASELINE		better cash flows SPP PROJECT since day 1	
Simple payback (net positive cummulative cash flow)		0.0	years

Note

BASELINE case financed by external FI to public entity, ESCO shared savings model financed by external FI to ESCO. Model includes Monitoring & Verification costs

CASE 2: ESCO model, ESA/shared-savings – air conditioning procurement policy

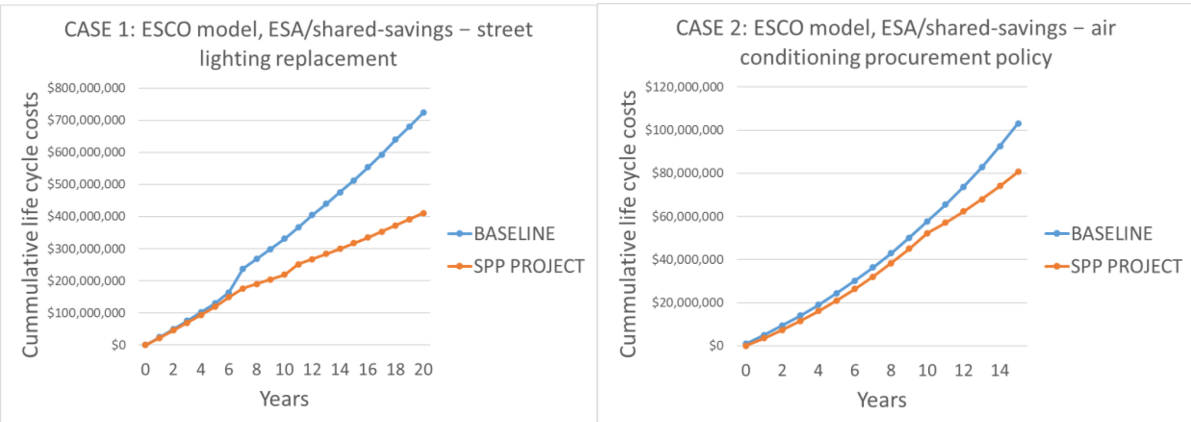
DELIVERY MODEL SETTINGS		
BASELINE Loan tenor	10	years
BASELINE Interest rate	20.0%	
BASELINE loan to project cost ratio	70.0%	
SPP PROJECT contract duration ESCO (same as loan tenor from FI)	10	years
SPP PROJECT share of savings provided to public entity during contract duration	0.0%	
SPP PROJECT interest rate (from FI to ESCO)	20.0%	
SPP PROJECT loan to project cost ratio (from FI to ESCO)	70%	
SPP PROJECT M&V annual costs (between 2-5% depending on project size, guarantee type, etc.)	5%	of savings
SPP PROJECT Safety margin on savings ESCO (between 5-15% depending on project & guarantee type)	0%	of savings
SPP PROJECT Expected savings after performance period	85%	of theoretical savings
SPP PROJECT Expected ESCO extra costs on installation (due to monitoring equipment, audits, etc.)	15%	of standard costs
SPP PROJECT Expected ESCO return on its own equity (for non-100% financed projects)	20%	

RESULTS	BASELINE	SPP PROJECT	
Project costs	$3,440,000	$8,395,000	
Initial investment	$1,032,000	$0	
Debt increase in balance sheet	$2,408,000	$0	
Lifetime costs	$103,141,833	$80,748,094	
IRR ESCO (model not attractive for ESCO if less than expected return)		22%	
Expected absolute profitability ESCO		$6,531,134	
ESCO gross margin		78%	
IRR SPP PROJECT vs BASELINE		better cash flows SPP PROJECT since day 1	
Simple payback (net positive cummulative cash flow)		0.0	years

Note

BASELINE case financed by external FI to public entity, ESCO shared savings model financed by external FI to ESCO. Model includes Monitoring & Verification costs

Figure 16. Cost evolution of ESA, shared savings model – sample lighting project and AC procurement policy



One of the most significant benefits to the public entity, which is the immediate net positive cash flow, is offset by the higher lifetime cost than self-developed projects.

The reason is two-fold. Firstly, the additional M&V costs add a financial burden to the project, similarly to the other ESCO models. Secondly, the ESCO/investor sets a target rate of return for their investment, which will depend on the risk profile of the client and the project. As a result, the share of savings that can be offered to the public entity is adjusted so that the ESCO/investor share can meet all costs and the expected return on the investment. If the project does not generate sufficient savings, the public entity share may be substantially reduced, or the project will not be of interest to the ESCO/investor.

4.5 ESCO model: MESA – financing the ESCO

The managed energy services agreement (MESA) model is a variation of the ESA model, which includes the payment of utility bills by the ESCO/investor on behalf of the public entity. Consequently, the service fee is calculated as the energy costs under the baseline scenario, minus a small percentage (the entity's guaranteed savings).

As in the ESA model, the ESCO then performs the capital investment on the equipment, which may be sold to an investor. The ESCO/investor pays the utility bills, amortising the installation through the difference between the agreed charges to the public entity and the reduced energy costs.

The benefits for the public entity are apparent and immediate, as it receives a discount on the energy costs from day one and benefits from an upgraded infrastructure without having to bear the capital expenditure or deal with the utility payments.

This model has the added benefit that the service charges may be considered as utility payments, depending on the legislation. This is useful in cases where the public entity is the landlord of a building which is being rented to a third party. In that case, the service fees may then be passed through to the tenants.

“Asset-as-a-service” models that include the payment of utility bills by the ESCO are more closely aligned with the MESA model than the ESA model. For example, in some cooling/heating-as-a-service projects, the ESCO installs a cooling plant with a dedicated electricity/fuel meter and a cooling/heating energy meter. The ESCO sells cooling/heating energy to the client at an agreed rate, while paying for the electricity/fuel consumption of the plant. In these cases, M&V procedures may be simplified, as the actual performance of the equipment does not have an effect on the financial benefit of the end-client.

The public entity is compelled to keep the payment flows, as they are associated with the payment of energy bills to the utility, meaning that a failure to perform those payments could result in electricity supply disconnection.

This model is summarised in Figure 17.

Figure 17. MESA model, with ESCO selling the assets to an investor

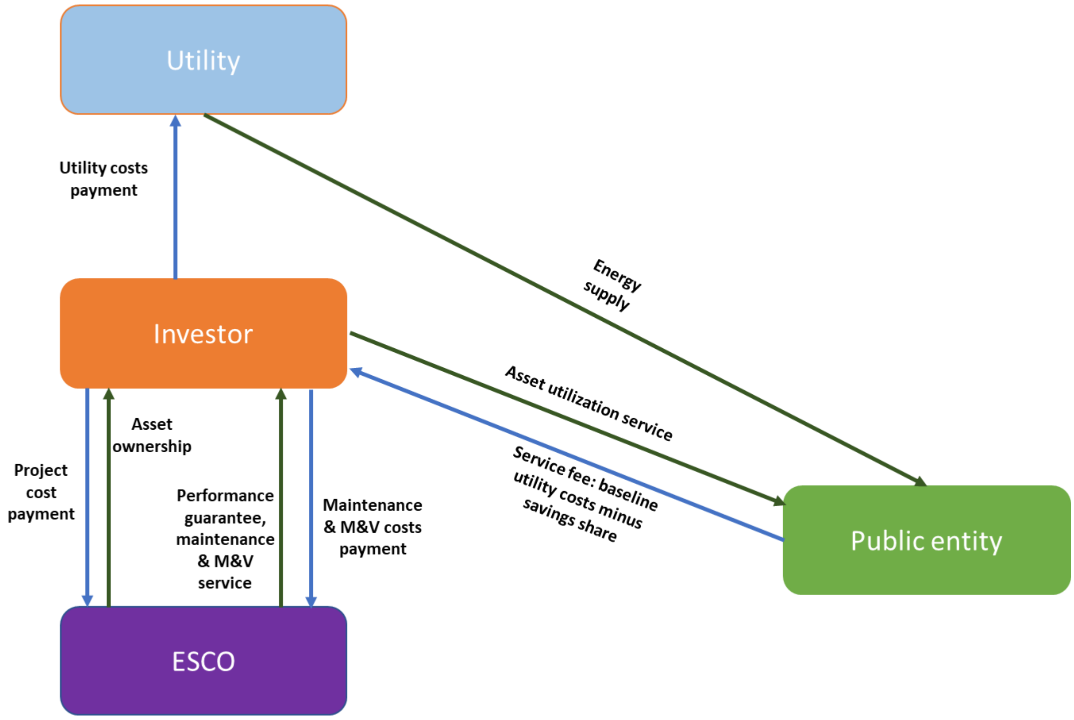


Table 14. Results of MESA model – sample lighting project and AC procurement policy

CASE 1: ESCO model, MESA/lighting as a service – street lighting replacement

DELIVERY MODEL SETTINGS		
BASELINE Loan tenor	0	years
BASELINE Interest rate	0.0%	
BASELINE loan to project cost ratio	0.0%	
SPP PROJECT contract duration ESCO (same as loan tenor from FI)	7	years
SPP PROJECT interest rate (from FI to ESCO)	12.0%	
SPP PROJECT loan to project cost ratio (from FI to ESCO)	70%	
SPP PROJECT M&V annual costs (between 2-5% depending on project size, guarantee type, etc.)	5%	of savings
SPP PROJECT Safety margin on utility costs ESCO (between 5-15% depending on project & guarantee type)	5%	of O&M costs
SPP PROJECT Expected savings after performance period	90%	of theoretical savings
SPP PROJECT Expected ESCO extra costs on installation (due to monitoring equipment, audits, etc.)	10%	of standard costs
SPP PROJECT Expected ESCO return on its own equity (for non-100% financed projects)	20%	

RESULTS	BASELINE	SPP PROJECT	
Project costs	$0	$52,250,000	
Initial investment	$0	$0	
Debt increase in balance sheet	$0	$0	
Lifetime costs (excluding externalities)	$723,962,134	$402,578,217	
Lifetime externalities costs			
IRR SPP PROJECT vs BASELINE		better cash flows SPP PROJECT since day 1	
Simple payback (net positive cummulative cash flow)		0.0	years

Note

BASELINE case financed by external FI to public entity, ESCO MESA model financed by external FI to ESCO. Model includes Monitoring & Verification, utility and maintenance costs in service fee

CASE 2: ESCO model, MESA/cooling as a service – air conditioning procurement policy

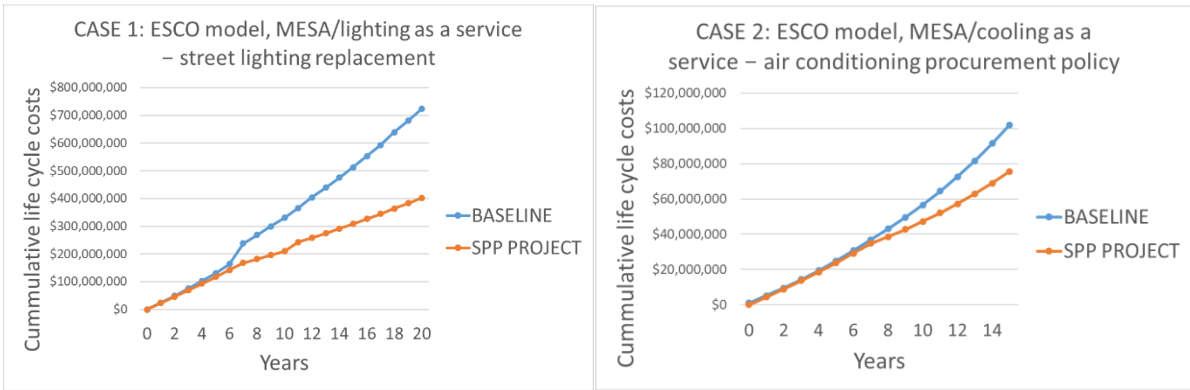
DELIVERY MODEL SETTINGS		
BASELINE Loan tenor	7	years
BASELINE Interest rate	20.0%	
BASELINE loan to project cost ratio	70.0%	
SPP PROJECT contract duration ESCO (same as loan tenor from FI)	7	years
SPP PROJECT interest rate (from FI to ESCO)	20.0%	
SPP PROJECT loan to project cost ratio (from FI to ESCO)	70%	
SPP PROJECT M&V annual costs (between 2-5% depending on project size, guarantee type, etc.)	5%	of savings
SPP PROJECT Safety margin on utility costs ESCO (between 5-15% depending on project & guarantee type)	5%	of operational costs
SPP PROJECT Expected savings after performance period	85%	of theoretical savings
SPP PROJECT Expected ESCO extra costs on installation (due to monitoring equipment, audits, etc.)	15%	of standard costs
SPP PROJECT Expected ESCO return on its own equity (for non-100% financed projects)	20%	

RESULTS	BASELINE	SPP PROJECT	
Project costs	$3,440,000	$8,395,000	
Initial investment	$1,032,000	$0	
Debt increase in balance sheet	$2,408,000	$0	
Lifetime costs	$102,049,209	$75,667,552	
IRR SPP PROJECT vs BASELINE		better cash flows SPP PROJECT since day 1	
Simple payback (net positive cummulative cash flow)		immediate	

Note

BASELINE case financed by external FI to public entity, ESCO MESA model financed by external FI to ESCO. Model includes Monitoring & Verification, utility and maintenance costs in service fee

Figure 18. Cost evolution of MESA model – sample lighting project and AC procurement policy



As in the case of the ESA model, if the contract is structured correctly, the public entity benefits from an immediate improvement in cash flow. The disadvantages are the relatively high lifetime costs compared to the self-developed projects and long duration of the contracts. This contract duration is required for the ESCO/investor to recover the costs of the investment, O&M and M&V, as well as its return on the investment.

4.6 Case studies

The following table contains a set of sample projects that illustrate public procurement of products aligned to a certain extent with the sustainable procurement criteria under various delivery mechanisms indicated in the Toolkit.

Table 15. Project case study summaries

Public entity	Location	Year	Technology	Delivery model	Notes
London Borough of Bromley[39]	UK	2019	LED street lighting	Standard project development, financed	3,870 streetlights replaced GBP 1.125 million project cost GBP 221,000 annual savings (excluding energy inflation) Concessional loan + own resources funding

[39] London Borough of Bromley, Report on Salix Street Lighting LED Upgrade, 2019. Available at https://cds.bromley.gov.uk/documents/s50071459/Salix%20Street%20Lighting%20LED%20Upgrade.pdf

Public entity	Location	Year	Technology	Delivery model	Notes
Eastern Shires Purchase Organization (ESPO)[40] [41]	UK	2020	LED street lighting White goods (incl. refrigerators)	N/A Procurement framework	The solution is a standardised framework for the purchase of equipment from vetted vendors – facilitates procurement for regional public entities
Visakhapatnam[42]	India	2014	LED street lighting	ESA	90,000 streetlights replaced; maintenance included USD 9.6 million project cost USD 4.7 million annual savings 7-year contract Part of EESL's Super-ESCO Street Lighting National Program (SLNP)
Nine municipalities[43]	India	2005	LED street lighting	ESA, shared savings	121,000 streetlights replaced 50 per cent savings 5-7 years contracts
Michigan Department of Transportation[44]	United States	2015	LED street lighting	ESA, service fee	13,000 streetlights replaced; maintenance included 15 years

[40] Eastern Shires Purchasing Organisation (ESPO), "Quick start guide to Framework 59, Street Lighting Solutions". Available at www.espo.org/amfile/file/download/file/4538/product/39803/

[41] Eastern Shires Purchasing Organisation (ESPO), "White Goods". Available at www.espo.org/whitegoods

[42] The World Bank - Energy Sector Management Assistance Programme (ESMAP), "Proven Delivery Models for LED Public Lighting, Super-ESCO Delivery Model in Vizag, India". Available at http://documents1.worldbank.org/curated/en/254011477930087398/pdf/Proven-delivery-models-for-led-public-lighting-super-ESCO-delivery-model-in-Vizag-India.pdf

[43] The World Bank - Energy Sector Management Assistance Programme (ESMAP), "Proven Delivery Models for LED Public Lighting, ESCO Delivery Model in Central and Northwestern India". Available at https://openknowledge.worldbank.org/bitstream/handle/10986/25347/109579-ESMAP-P152422-PUBLIC-FINAL-ESMAP-LED-PublicLighting-AEL-India-CS1-KS026-16-opt.pdf

[44] Michigan Freeway Lighting Partners, project website. Available at http://michiganfreewaylighting.com

Public entity	Location	Year	Technology	Delivery model	Notes
Jimena de la Frontera[45]	Spain	2013	LED street lighting	MESA	€1.5M contract value 10 years of contract duration Design, construction, maintenance and bill payment managed by ESCO
Government wide[46 47]	Hong Kong	2019	Air conditioners	N/A Procurement policy	Mandatory criteria for all AC purchased by the government: Level 1 (highest efficiency class), recommended no HCFC
Nationwide[48]	India	2019	Air conditioners	N/A	EESL's Super-Efficient AC Programme (ESEAP) – bulk procurement programme
Nationwide[49]	Malaysia	2020	Air conditioners	N/A Procurement policy	Mandatory eco-label criteria for AC purchased under Green Government Procurement, which is targeted to represent 20% of government purchase.

[45] European Commission, "Energy performance contracting for efficient outdoor lighting", GPP in practice, Issue 63, 2016. Available at https://ec.europa.eu/environment/gpp/pdf/news_alert/Issue63_Case_Study_127_Cadiz_Outdoor_Lighting.pdf
[46] Government of Hong Kong, Environmental Protection Department, Green Procurement web pages. Available at www.epd.gov.hk/epd/english/how_help/green_procure/green_procure.html#a2
[47] Government of Hong Kong, Environmental Protection Department, Green Public Procurement Criteria for electrical and gas appliances and light fittings". Available at www.epd.gov.hk/epd/sites/default/files/epd/english/how_help/green_procure/files/F07.pdf
[48] Energy Efficiency Services Limited (EESL) India. Super-Efficient AC Program information available at https://eeslindia.org/en/super-efficient-ac/
[49] Malaysia's Green Recognition Scheme, Green Procurement Guidelines, Available at: www.myhijau.my/wp-content/uploads/2021/01/GGP-Guidelines-3.0.pdf

4.7 Resources

(a) U4E Model Regulations Guidelines for lighting, refrigerators and AC. MEPS[50]
(b) U4E Policy Guides[51]
(c) U4E GPP Technical Guidelines and Specifications[52]
(d) EU GPP Portal[53]
(e) One Planet Network SPP initiative[54] [55]
(f) GIZ Proklima [56]
(g) Model ESCO contracts (various models and jurisdictions, use only as guidance)[57] [58]

5 ESG Risk Assessment of Vendors and Equipment Manufacturers

This section contains a set of proposed parameters that aim to filter vendors and manufacturers carrying a significant environmental, social, or governance risk. They are based on the applicable sustainability considerations identified in Section 2.

The application of these criteria to international manufacturers may be difficult. International organisations such as the World Bank, or the UN Office for Project Services (UNOPS) maintain lists of debarred entities. Commercial ESG screening solutions also exist that allow entities to perform risk assessments on vendors and manufacturers.

[50] https://united4efficiency.org/resources/model-regulation-guidelines/
[51] https://united4efficiency.org/resources/protocols-to-conduct-market-and-impact-assessments/
https://united4efficiency.org/resources/ensuring-compliance-with-meps-and-energy-labels/
https://united4efficiency.org/resources/accelerating-global-adoption-energy-efficient-lighting-2/
https://united4efficiency.org/resources/accelerating-global-adoption-energy-efficient-air-conditioners/
https://united4efficiency.org/resources/accelerating-global-adoption-energy-efficient-refrigerators/
[52] Not yet published as of this writing. They will be available in the Publications section of the U4E website, https://united4efficiency.org/resources/publications/. The reader is advised to visit the website for the latest version once they are published.
[53] https://ec.europa.eu/environment/gpp/index_en.htm
[54] www.oneplanetnetwork.org/sustainable-public-procurement
[55] www.oneplanetnetwork.org/knowledge-hub
[56] Proklima, Guidelines for the safe use of hydrocarbon refrigerants. Available at https://www.green-cooling-initiative.org/fileadmin/Publications/2012_Proklima_Guidelines_for_the_safe_use_of_hydrocarbons.pdf
[57] www.energy.gov/eere/slsc/model-documents-energy-savings-performance-contract-project
[58] www.ase.org/sites/ase.org/files/ee_roadmap-annex2.pdf

Table 16. Proposed SPP organizational specifications for vendors

<table>
<tr><th colspan="2">Organisational Specifications for Vendors</th></tr>
<tr><th>Parameter</th><th>Specifications</th></tr>
<tr><td>Hazardous substance management</td><td>Vendors shall abide by the applicable national environmental regulations, which may include:
The Environment (Protection) Rules,
Hazardous Waste (Management, Handling and Transboundary Movement) Rules,
E-Waste (Management) Amendment Rules,
Plastic Waste (Management and Handling) Rules,
Solid Waste (Management) Rules,
The Plastics (Manufacture, Usage and Waste Management) Rules,
The Recycled Plastics Manufacture and Usage Rules,
Batteries (Management and Handling) Rules,
The Manufacture, Storage and Import of Hazardous Chemical Rules.
Vendors sanctioned for breaches of National Environmental Law in the last five years shall not be eligible to participate in the tender.</td></tr>
<tr><td>Labour laws</td><td>Vendors shall comply with the National Labour Law (for local companies) or International Labour Organization standards (for international companies), as specified within the provisions of the various Rules and Regulations prepared from time to time.

Vendors sanctioned for breaches of National Labour Law in the last five years shall not be eligible to participate in the tender.</td></tr>
<tr><td>Employee health and safety and gender inclusivity</td><td>Vendors shall have internal policies and guidelines to promote employee health and safety and equal opportunities for employment and advancement.

Vendors participating in air conditioning procurement processes must prove that their technicians have received proper training in the installation and service of units with the refrigerant proposed.</td></tr>
<tr><td>Tax compliance</td><td>Vendors shall not have outstanding tax, social insurances or pensions obligations.

Vendors who are in receivership, or insolvency proceedings, debarred from participating in public procurement, or sanctioned in connection to a procurement proceeding, or that have committed crimes to gain financial profit shall not be eligible to participate in the tender.</td></tr>
</table>

Table 17 Proposed SPP organizational specifications for equipment manufacturers

Organisational Specifications for Equipment Manufacturers	
Parameter	**Specifications**
Hazardous substance management	The manufacturer shall abide by the applicable national environmental regulations, which may include: • The Environment (Protection) Rules, • Hazardous Waste (Management, Handling and Transboundary Movement) Rules, • E-Waste (Management) Amendment Rules, • Plastic Waste (Management and Handling) Rules, • Solid Waste (Management) Rules, • The Plastics (Manufacture, Usage and Waste Management) Rules, • The Recycled Plastics Manufacture and Usage Rules, • Batteries (Management and Handling) Rules, • The Manufacture, Storage and Import of Hazardous Chemical Rules.
Noise pollution	The manufacturing facilities shall comply with the noise standards for industrial facilities, as specified with the national legislation in the country of manufacture of the equipment proposed. Additionally, all such facilities should take measures for the abatement of noise, including noise emanating from the sound-producing equipment or instruments, and should ensure that existing noise levels do not exceed ambient air quality standards specified. All planned developmental activity related to industrial manufacturing or distribution of manufactured products should take noise pollution aspects into consideration and should avoid noise menace. The recommended ambient noise levels shall always be adhered to by cooling appliance manufacturing facilities.
Ozone depletion	No manufacturing facility shall employ equipment that releases ozone depleting substances, and all existing equipment should be in the process of phasing out ozone-depleting substances. No manufacturing facility shall export or import ozone-depleting substances, equipment, or instruments to any country. No manufacturing facility or any associated person(s), shall sell, stock, or exhibit for local or international sales, any ozone-depleting substance, equipment, or instrument. No manufacturing facility or any associated person(s), shall establish, expand, or invest in, ozone-depleting substances, equipment, or instruments.
Environmental management system (EMS) certification	The manufacturer shall comply with ISO 14001 (EMS – Environmental Management System).

Organisational Specifications for Equipment Manufacturers	
Parameter	**Specifications**
Corporate social responsibility	The manufacturer shall comply with corporate social responsibility (CSR) Norms as per local legislation, if applicable.
Labour laws	The manufacturer shall comply with the National Labour Law (for local companies) or International Labour Organization standards (for international companies), as specified within the provisions of the various Rules and Regulations prepared from time to time. Manufacturers sanctioned for breaches of National Labour Law in the last five years shall not be eligible to participate in the tender.
Employee health and safety and gender inclusivity	The manufacturer shall have internal policies and guidelines to promote employee and staff health and safety and equal opportunities for employment and advancement.
Tax compliance	Manufacturers shall not have outstanding tax, social insurances or pensions obligations. Manufacturers who are in receivership, or insolvency proceedings, debarred from participating in public procurement, or sanctioned in connection to a procurement proceeding, or that have committed crimes to gain financial profit shall not be eligible to participate in the tender.

6 Proposed Technical Specifications and Award Criteria

The performance requirements provided in this section refer to product characteristics summarizing the GPP Technical Guidelines and Specifications developed by UNEP U4E[59]. Those documents provide comprehensive guidance on the technical requirements proposed for SPP equipment and should be used as the primary source of information when developing technical specifications under an SPP programme. The criteria presented should nonetheless be taken as complementary to other (potentially legally mandated) criteria which will be applicable in electromechanical installations.

Comprehensive projects tend to include functional specifications for the complete project (for example, illuminance, light uniformity, light trespass, terminal unit minimum supply air temperature, installed cooling capacity per zone, etc.). The reader is advised to refer to standard procurement criteria for these design parameters.

[59] The technical specifications for lighting, refrigeration and air conditioners are yet to be published at time of writing. They will be available in the Publications section of the U4E website, https://united4efficiency.org/resources/publications/. The reader is advised to visit the website for the latest version once they are published.

6.1 Proposed technical specifications for lighting

The proposed performance requirements for lighting are divided into two categories: street/outdoor lighting and indoor lighting. Details of these are given in Table 18 and Table 19 respectively.

Table 18. Proposed SPP technical specifications for street lighting

Performance Criteria	Standard Public Procurement Requirements
Efficacy of the luminaire	120 lm/W for luminaires rated up to 90W 140 lm/W for luminaires rated at more than 90W
Lifetime	$L_{70}B_{50}$ shall not be less than 50,000 hours.
Photometry distribution	ULOR ≤ 1% for a tilt angle of 0°
Colour rendering index (CRI)	CRI ≥ 70
Corelated colour temperature (CCT)	CCT ≤ 5,000 Kelvin
CCT tolerance	Maximum CCT deviation of +/- 300 Kelvin
Flicker	Pst^{LM} ≤ 1.0 at full load and a sinusoidal input voltage
Stroboscopic effect	SVM ≤ 1 at full load
Operational voltage range	160 VAC to 250 VAC at 50Hz or 60 Hz
Fundamental power factor	≥ 0.9
Standby power	≤ 0.5 W or ≤ 1.5 W when connected to an interactive control device
Surge protection	IEC 61547:2020 standard recommendations
Harmonic distortion	IEC 61000-3-2:2018 standard
Protection against electrical shock	Norm IEC 60598-1 Luminaires – Part 1: General requirements and tests
class of ingress protection	IP66 or IP65 where no heavy rain is expected
Class of impact resistance	Minimum IK08

Performance Criteria	Standard Public Procurement Requirements
Humidity and corrosion	Comply with IEC 60598:1, Ed.9 norm for humidity testing with initial luminaire temperature of 34°C, placed in a cabinet containing air with a relative humidity maintained between 91 % and 95 % and a temperature of 30°C+/-1°C The outside metal envelope components of the luminaire should be made of stainless steel or aluminium (sheet, extruded or cast) or die-cast zinc. Iron coated with zinc can be acceptable with special characteristics
Dimming	LED lighting should be dimmed by 30% of its nominal flux for at least 4 hours per night (for example from 1 am to 5 am) Not applicable if the nominal illuminance level is below 1 lux
Performance criteria	Power installed should not be more than 3 W per linear meter per road lane
Warranty	At least 3 years
Maintenance	Luminaire should be maintainable and designed for serviceability, preferably with replaceable module

Table 19. Proposed SPP technical specifications for indoor lighting

<table>
<tr><th>Performance Criteria</th><th>Standard Public Procurement Requirements</th></tr>
<tr><td>Efficacy of the luminaire</td><td>[<table>
<tr><td>Flux bandwidth</td><td>60 lm ≤ Φ < 600 lm</td><td>600 lm ≤ Φ < 1,200 lm</td><td>1,200 lm ≤ Φ</td></tr>
<tr><td>Efficacy</td><td>100 lm/W</td><td>110 lm/W</td><td>120 lm/W</td></tr>
</table></td></tr>
<tr><td>Lifetime</td><td>$L_{70}B_{50}$ shall not be less than 20,000 hours.</td></tr>
<tr><td>Colour rendering index (CRI)</td><td>CRI ≥ 80</td></tr>
<tr><td>Corelated colour temperature (CRI)</td><td>CCT ≤ 6,000 Kelvin (maximum)</td></tr>
<tr><td>CCT tolerance</td><td>Maximum CCT deviation of +/- 300 Kelvin</td></tr>
<tr><td>Flicker</td><td>Pst^{LM} ≤ 1.0 at full load and a sinusoidal input voltage</td></tr>
<tr><td>Stroboscopic effect</td><td>SVM ≤ 0.4 at full load</td></tr>
<tr><td>Operational voltage range</td><td>160 VAC to 250 VAC at 50Hz or 60 Hz</td></tr>
</table>

Performance Criteria	Standard Public Procurement Requirements
Fundamental power factor	≥ 0.7
Standby power	≤ 0.5 W or ≤ 1.5 W when connected to an interactive control device
Surge protection	IEC 61547:2020 standard recommendations
Harmonic distortion	IEC 61000-3-2:2018 standard
Protection against electrical shock	Norm IEC 60598-1 Luminaires – Part 1: General requirements and tests
Class of ingress protection	IP20 or IP54 in industrial environment
Class of impact resistance	Minimum IK05 (IK08 for luminaire fixed on the wall)
Humidity and corrosion	Comply with IEC 60598:1, Ed.9 norm for humidity testing with initial luminaire temperature of 34°C, placed in a cabinet containing air with a relative humidity maintained between 91 % and 95 % and a temperature of 30°C+/-1°C The outside metal envelope components of the luminaire should be made of stainless steel or aluminium (sheet, extruded or cast) or die-cast zinc. Iron coated with zinc can be acceptable with special characteristics
Dimming and occupancy control	LED lighting should be dimmed when daylight is sufficient LED luminaires should incorporate automatic on/standby occupancy control/presence detection
Performance criteria	Power installed should be < 8W/m^2 of floor area
Warranty	At least 3 years
Maintenance	Luminaire should be maintainable and designed for serviceability, preferably with replaceable module

6.2 Proposed award criteria for lighting

The proposed weightings and parameters for street and indoor lighting are given in Table 20. These may be adjusted to comply with local regulations.

Table 20. Proposed award criteria for lighting

<table>
<tr><th colspan="2">Award Criteria for Street lighting and Indoor lighting</th></tr>
<tr><td colspan="2">Proposed point-based system, maximum 100 points</td></tr>
<tr><th>Parameter</th><th>Criteria</th></tr>
<tr><td>Life cycle cost</td><td>40 per cent weight
Points = 40 x (lowest life cycle cost of all proposals/life cycle cost of proposal)
The life cycle cost calculations shall follow a standardised method, for example, as provided in the sample calculation spreadsheet provided as part of this Toolkit
The respondents to the tender may only need to provide basic input data as part of their proposal: total cost of installation, maintenance intervals, lifetime of luminaires, etc.</td></tr>
<tr><td>Purchase cost</td><td>20 per cent weight
Points = 20 x (lowest purchase cost of all proposals/purchase cost of proposal)</td></tr>
<tr><td>Extended warranty</td><td>20 per cent weight
• Minimum + 1 year: 4 points
• Minimum + 2 years: 8 points
• Minimum + 3 years: 12 points
• Minimum + 4 years: 16 points
• Minimum + 5 years or more: 20 points</td></tr>
<tr><td>Luminous efficacy</td><td>10 per cent weight
Points = 10 x (luminous efficacy proposal/maximum luminous efficacy all proposals)</td></tr>
<tr><td>Local content (if permissible by regulations)</td><td>10 per cent weight
LC = local content cost of proposal (materials & labour)/total purchase cost
Points = 10 x LC proposal / highest LC of all proposals</td></tr>
</table>

In the case that the procurement criteria do not allow the utilisation of an LCC analysis, the LCC weighting shall be transferred to the luminous efficacy parameter. This is because, with the same design parameters, the luminous efficacy has the most significant impact on the LCC.

6.3 Proposed technical specifications for air conditioners

The proposed technical specifications for air conditioners are given in Table 21. They are based on international standards and the U4E model regulation guidelines [60]. These specifications have been defined in the Toolkit on an interim basis, until the U4E GPP Technical Guidelines and Specifications for Air Conditioners are developed.[61] Depending on the national legislation, the criteria may need to be updated according to national standards.

Table 21. Proposed SPP technical specifications for air conditioners

Criteria	Parameter	Recommendation for SPP
Energy consumption	Type and size	Avoid portable ACs if possible and chose the size according to the cooling demand (oversized ACs consume more energy).
	Energy efficiency	Target the efficiency class corresponding to the 20% most energy efficient models in the market.
	Speed compressors	Prioritize variable speed compressors (inverter).
	Occupancy and temperature limiting controls	Include embedded occupancy and temperature limiting controls in the specifications wherever possible and relevant. Include peak power load management and connected 'smart' controls in the specifications where relevant.
	Reversible units	Use reversible units if heating is needed and where no other more efficient heating system is in place.
Refrigerants	ODP	ODP = 0
	GWP	Prioritize natural refrigerants (different GWP limits apply depending on size and type as per Table 3 of the GPP Technical Guidelines and Specifications for Air Conditioners[Error! Bookmark not defined.]).
Sound power	Maximum db	60 dB (indoor) and 65 (outdoor) when <6kW 65 dB (indoor) and 70 (outdoor) when >6kW
Safety	Product and installation	The product shall meet all local safety requirements and technicians for installation and maintenance should be qualified for the specific products.
Product durability	Spare parts	The manufacturer/supplier should ensure availability of spare parts, even when the model is no longer in the market.
	Information	The manufacturer/supplier should make available the repair and maintenance information.
	Warranty	A complete warranty for a minimum of one (1) year and three (3) years for all the main operational components.

[60] Model Regulation Guidelines for Energy-efficient and Climate-friendly Air Conditioners, U4E 2019. Available at https://united4efficiency.org/resources/model-regulation-guidelines-for-energy-efficient-and-climate-friendly-air-conditioners/

[61] They will be available in the Publications section of the U4E website at https://united4efficiency.org/resources/publications/. The reader is advised to visit the website for the latest version once they are published.

Criteria	Parameter	Recommendation for SPP
Environmentally sound management	Dismantling	Facilitate material recovery (for re-use) and recycling while avoiding pollution
	Take back requirements	Manufacturer/supplier should ensure the correct environmental disposal of the air conditioner at the end of life.
	Packaging	Minimum possible to facilitate handling the equipment and it should be recyclable.
Social criteria	Decent work	Complies with national and international decent work standards.

6.4 Proposed award criteria for air conditioning

The proposed weightings and parameters for air conditioners are given in Table 22. These may be adjusted to comply with local regulations.

Table 22. Proposed award criteria for air conditioning

Award Criteria for Air Conditioning	
Proposed point-based system, maximum 100 points	
Parameter	**Criteria**
Life cycle cost	*40 per cent weight* Points = 40 x (lowest life cycle cost of all proposals/life cycle cost of proposal) The life cycle cost calculations shall follow a standardised method, for example, as provided in the sample calculation spreadsheet provided as part of this Toolkit The respondents to the tender may only need to provide basic input data as part of their proposal: total cost of installation, maintenance intervals, etc.
Product purchase cost	*20 per cent weight* Points = 20 x (lowest purchase cost of all proposals/purchase cost of proposal)
Extended warranty	*20 per cent weight* • Minimum + 1 year: 4 points • Minimum + 2 years: 8 points • Minimum + 3 years: 12 points • Minimum + 4 years: 16 points • Minimum + 5 years or more: 20 points

Award Criteria for Air Conditioning	
Proposed point-based system, maximum 100 points	
Parameter	**Criteria**
Total equivalent warming impact (TEWI)[62]	*10 per cent weight* Points = 10 x (lowest TEWI of all proposals / TEWI of proposal)
Local content (if permissible by regulations)	*10 per cent weight* LC = local content cost of proposal (materials & labour)/total purchase cost Points = 10 x LC proposal/highest LC of all proposals

In the case that the procurement criteria do not allow the utilisation of an LCC analysis, the LCC weighting shall be transferred to the energy efficiency parameter. This is because, with the same design parameters, the CSPF of the equipment has the greatest impact on the LCC.

6.5 Proposed technical specifications for refrigeration

Proposed technical specifications for refrigerating equipment have been developed for four equipment categories:

(a) Domestic refrigerating appliances
(b) Commercial refrigerating appliances
(c) Vending machines
(d) Laboratory-grade refrigerating appliances

The summary specifications for these are shown in Table 23, Table 24, Table 25 and Table 26 respectively. More detailed guidance, that can be used to develop technical specifications for tenders, is provided in the UNEP U4E GPP technical guidelines and specifications for refrigerating appliances.[63]

[62] TEWI is calculated as the sum of indirect GHG emissions from energy consumption, direct GHG emissions from refrigerant leakage during installation, use, and end-of-life.
[63] Green Public Procurement Technical Guidelines and Specifications for Energy-Efficient Refrigeration Appliances. Unpublished at time of writing. They will be available in the Publications section of the U4E website at https://united4efficiency.org/resources/publications/. The reader is advised to visit the website for the latest version once they are published.

Table 23. Proposed SPP technical specifications for domestic refrigerating appliances

Aspect	Parameter	Criteria
Energy consumption	Energy efficiency	Target the efficiency class in the energy label corresponding to around the 20% most energy-efficient models in the market
	Volume	Optimize volume depending on needs, do not oversize Rationalise the total number of refrigerators
	Installation	Prioritize free-standing installation
	Functions	Functions that require more energy consumption should come back to normal operation after use
Refrigerants	ODP	ODP = 0
	GWP	GWP ≤ 20 and prioritise natural refrigerants
Food preservation	Type of compartment	Select the right compartment combination (target temperature), depending on the need
	Climatic zone	Chose the right climatic zone depending on the ambient temperature where the refrigerator will be installed
Product durability	Spare parts	The manufacturer/supplier should ensure availability of spare parts, even when the model is no longer in the market
	Information	The manufacturer/supplier should make available the repair and maintenance information
Environmentally sound management	Dismantling	Facilitate material recovery (for re-use) and recycling while avoiding pollution
	Take-back requirements	Manufacturer/supplier should ensure the correct environmental disposal of the refrigerator at the end of life
	Packing	Minimum possible to facilitate handling the equipment and it should be recyclable
Social criteria	Decent work	Complies with national and international decent work standards

Table 24. Proposed SPP technical specifications for commercial refrigerating appliances

Aspect	Parameter	Criteria
Energy consumption	Energy efficiency	Target the efficiency class in the energy label corresponding to around the 20% most energy-efficient models in the market (Prioritize solid doors instead of transparent)
	Volume	Optimize volume depending on needs, do not oversize Rationalise the total number of refrigerators.
	Light	LED light and smart control
Refrigerants	ODP	ODP = 0
	GWP	Prioritize GWP ≤ 20 (natural refrigerants)
Food preservation	Ambient temperature	Chose the right climatic zone or ambient temperature and humidity depending on the application
Product durability	Spare parts	The manufacturer/supplier should ensure availability of spare parts, even when the model is no longer in the market
	Information	The manufacturer/supplier should make available the repair and maintenance information
Environmentally sound management	Dismantling	Facilitate material recovery (for re-use) and recycling while avoiding pollution
	Take-back requirements	Manufacturer/supplier should ensure the correct environmental disposal of the refrigerator at the end of life
	Packing	Minimum possible to facilitate handling the equipment and it should be recyclable
Social criteria	Decent work	Complies with national and international decent work standards

Table 25. Proposed SPP technical specifications for vending machines

Aspect	Parameter	Criteria
Energy consumption	Energy efficiency	Target the efficiency class in the energy label corresponding to around the 20% most energy-efficient models in the market
	Volume	Rationalise the total number of units (optimize location)
	Light	LED light and smart control
Refrigerants	ODP	ODP = 0
	GWP	Prioritize GWP $\leq$ 150
Food preservation	Ambient temperature	Chose the right climatic zone or ambient temperature and humidity
Product durability	Contract	The contract should include best maintenance practices to ensure that the unit will work efficiently during the whole lifespan
Environmentally sound management	Dismantling	Facilitate material recovery (for re-use) and recycling while avoiding pollution
	Take-back requirements	Manufacturer/supplier should ensure the correct environmental disposal of the refrigerator at the end of life
	Packing	Minimum possible to facilitate handling the equipment and it should be recyclable
	Use phase	Enable the use of reusable cups instead of disposable cups
Social criteria	Decent work	Complies with national and international decent work standards
	Food and drink	Offer a list of health food and drink items, targeting products from organic sources which are produced and traded in accordance with the requirements of a fair and ethical trade certification scheme

Table 26. Proposed SPP technical specifications for laboratory-grade refrigeration equipment[64]

Target volume (± 30 L)	Maximum Energy Consumption for SPP (kWh/day)			
	Refrigerator GP	Refrigerator HP	Freezer HP	ULT Freezer
250	3.09	5.12	10.79	4.86
310	3.36	5.51	10.99	6.02
370	3.62	5.90	11.18	7.19
430	3.88	6.29	11.37	8.35
490	4.15	6.68	11.56	9.52
550	4.41	7.07	11.75	10.68
610	4.67	7.46	11.94	11.85
670	4.93	7.85	12.71	13.01
730	5.20	8.24	13.61	14.18
790	5.45	8.55	14.51	15.34
850	5.70	8.87	15.42	16.51
910	5.96	9.20	16.32	17.67
970	6.21	9.52	17.22	18.84
1030	6.47	9.84	18.12	20.00
1090	6.73	10.17	19.03	21.17
1150	6.98	10.49	19.93	22.33
1210	7.24	10.82	20.83	23.50
1270	7.50	11.11	21.73	24.66
1330	7.75	11.37	22.64	25.83
1390	8.01	11.64	23.54	26.99
1450	8.27	11.90	24.44	28.16
1510	8.52	12.16	25.34	29.32
1570	8.78	12.43	26.25	30.49
1630	9.03	12.69	27.15	31.66

[64] GP stands for general purpose. HP stands for high performance, and ULT stands for ultra-low temperature

6.6 Proposed award criteria for refrigerators

The proposed weightings and parameters for refrigeration appliances are shown in Table 27. These may be adjusted to comply with local regulations.

Table 27. Proposed award criteria for refrigerating appliances

Award Criteria for refrigerators	
Proposed point-based system, maximum 100 points	
Parameter	**Criteria**
Life cycle cost	*40 per cent weight* Points = 40 x (lowest life cycle cost of all proposals/life cycle cost of proposal) The life cycle cost calculations shall follow a standardised method, for example, as provided in the sample calculation spreadsheet provided as part of this Toolkit The respondents to the tender may only need to provide basic input data as part of their proposal: total cost of installation, maintenance intervals, lifetime of luminaires, etc.
Product purchase cost	*20 per cent weight* Points = 20 x (lowest purchase cost of all proposals/purchase cost of proposal)
Extended warranty	*20 per cent weight* • Minimum + 1 year: 4 points • Minimum + 2 years: 8 points • Minimum + 3 years: 12 points • Minimum + 4 years: 16 points • Minimum + 5 years or more: 20 points
Refrigerant and blowing agent GWP	*10 per cent weight* Points = 10 for products using refrigerants and blowing agents with GWP < 10 Products with only one component meeting the criteria (refrigerant or blowing agent) will not obtain any point
Local content (if permissible by regulations)	*10 per cent weight* LC = local content cost of proposal (materials & labour)/total purchase cost Points = 10 x LC proposal/highest LC of all proposals

In the case that the procurement criteria do not allow the utilisation of an LCC analysis, the LCC weighting shall be transferred to the energy efficiency parameter. This is because, with the same design parameters, the efficiency of the equipment has the most significant impact on the LCC.

7 Proposed Actions of an SPP Policy and Action Plan for Lighting, Refrigerators, and Air Conditioning

The development of an SPP policy and action plan is a key part of implementing SPP. It provides a clear direction and a mandate for implementation. If the country has an overarching policy that supports sustainable procurement, the SPP policy aspect may not be required.

As a first step, the government officials preparing the SPP action plan, should assess the cost-benefit of developing standardized procurement criteria/policy for cooling and lighting products. The Excel spreadsheet tool developed to complement the Toolkit[65], contains financial assessment models that allow government officials to develop a cost-benefit assessment, considering the product quantities involved.

In the case that a standardized procurement criteria is deemed not suitable, a project-by-project approach may be taken. If funds are not available, government officials are encouraged to identify the barriers blocking funding.

Split incentives between the entity bearing the capital cost of the equipment procured and the entity responsible for bearing the operational costs may be a significant barrier. If a cost-benefit assessment is not sufficient to unlock funding for sustainable products, an inter-agency agreement governing a fair distribution of the project benefits may be developed.

Another common barrier is the low receptiveness for SPP project proposals during the regular budgeting cycles. As indicated in Section 3.3 the main interest in SPP programmes from the decision makers may stem from the additional benefits that the programmes may provide, hence, it is essential to address those additional benefits in the proposal.

Finally, and depending on the availability of funding, alternative delivery models may be developed. These require a thorough assessment of existing procurement regulations, public finance management limitations, accounting regulations, as well as the presence of vendors in the market that can offer these models. Figure 19 presents a process diagram of the proposed approach to the implementation of sustainable projects and the logical steps to assess the suitability of the various delivery models. The final stages in the diagram, that require further regulatory review or clarification, may be used as input to develop the SPP action plan in a targeted approach that enables the deployment of an SPP programme.

[65] Available on the U4E website at https://united4efficiency.org/resources/tools/

Figure 19. Proposed SPP action plan for lighting and air conditioner projects