User Guide to the

Life Cycle Costing Tool

for Green Public Procurement of

Indoor Lighting

The LCC Tool for Indoor Lighting

What is the LCC tool for?

The purpose of the tool is to encourage and facilitate the wide application of life cycle costing (LCC) among public authorities in the European Union, so that organisations can **make more cost-effective decisions** in their procurement processes for indoor lighting.

Purchasing price is only a small fraction of all costs of any given product or service. Calculating life cycle costs allows you to be aware of future expenditure and select more cost-effective solutions. To do so, the LCC tool allows you to consider:

- **Initial acquisition costs** (purchase, installation and other initial costs),
- **Operating and maintenance costs** (especially due to energy consumption and the replacement of parts),
- **Other costs** (such as taxes or interest) and
- **Costs of environmental externalities**, namely those associated with climate change/CO_2 emissions due to the energy consumption during operation.

This guide provides you with the key aspects to consider when using LCC in public procurement, especially during the preparatory and tendering stages, and introduces briefly the main sections and elements of the LCC tool itself.

Who is this tool intended for?

The LCC tool has been developed for procurement practitioners in public organisations in the European Union.

It is designed for procurement both below and above the thresholds for application of the EU procurement directives (Directives 2014/24/EU on public procurement and 2014/25/EU on procurement by entities operating in the water, energy, transport and postal services sectors).

However, it can also be used by private sector purchasers and even the general public.

For which products can this tool be used?

This user guide contains the basic information to start using LCC in the procurement of **indoor lighting,** i.e. lamps, luminaires and control gears installed inside buildings **for regular lighting needs**.

Specialist lighting (such as display lighting, emergency lighting, medical lighting, etc.) is not covered even though some recommendations could still apply.

When to use the tool?

The tool has been designed to be used during tendering processes. However, that is not the only stage in a procurement process when it can be applied. You can use the tool:

BEFORE TENDERING
To assess the LCC of the current situation and roughly evaluate different solutions to help guide pre-tendering market engagement activities, or to narrow down different technological solutions.
DURING TENDERING
To compare offers during the evaluation and award of contracts, as foreseen in Directives 2014/24/EU on public procurement and 2014/25/EU on procurement by entities operating in the water, energy, transport and postal services sectors.
AFTER TENDERING
To evaluate the performance of the awarded solution in comparison to the previous situation or other offers, to monitor and communicate results and help prepare future tenders.

I. Prior to the tendering process

Before starting the tendering process, it is important to know what your real lighting needs are, what solutions exist to cover them and which have lower life cycle costs. To do so you need to involve internal stakeholders and consult with the market.

Not all cost drivers are easily included in LCC; you should be aware of that and decide which elements to include in the LCC and which to consider separately as additional criteria, to select the best solution for your needs and for the environment.

Determine your needs

Prior to tendering, you need to define the lighting needs of each area in the building or in the tendering process in order to provide "the right light at the right time and the right place."[1]

Lighting needs for suitable visual conditions will depend on the activities conducted in each area or to be conducted in the future, occupancy patterns, existing natural light, type of building occupants or users, etc.

Take those aspects into consideration as well as existing building and lighting regulations and recommendations in your region or at the EU level to define the lighting needs of your project.

Identify solutions for those needs

There are many options to cover your needs in an environmentally friendly and cost-effective manner when you take your time to evaluate the options.

Consultation with internal stakeholders and the market is key, especially when retrofitting existing installations or if you want to opt for new contract arrangements like energy service contracts or light-as-service contracts to cover your lighting needs.

Consider installing lighting control systems

Lighting control gear systems help to avoid wasting energy (and money) in areas where lighting is not always needed, where lighting could be dimmed based on occupants' needs or to dim the light at the beginning of the installation when the lighting is above the requirements to ensure the minimum required illumination during the lamp's useful lifespan.

Nowadays there are a lot of options on the market (manual, automatic, intelligent, direct, remote, combined). You should analyse them and evaluate the potential savings of each option in order to develop your tender specifications.

When doing so, include contract performance clauses to ensure the fine-tuning of control gears after their installation and that appropriate training is provided to building energy managers, maintenance staff and/or occupants, depending on the system.

The relevance of maintenance in the design of the installation

As time passes, the efficiency of lighting systems deteriorates due to aging of luminaire parts (diffusers, reflectors, lamps…) as well as due to the accumulation of dirt on them and on room surfaces.

When considering different options, take those maintenance factors into consideration to lower maintenance costs (both in terms of components purchase and labour costs) during the lifetime of the installation.

[1] Energy piano (2017). Indoor Lighting in the Public and Private Service Sectors. Guidelines. EU-project Premium Light Pro Consortium.

Identify relevant cost drivers and parameters

Different solutions have different costs throughout their life cycle. Analysing the expenses and organisational changes associated with each of them at this preliminary stage will help you have the full costs picture and unveil "hidden" costs to better evaluate alternatives from an economic point of view. Operation and maintenance costs will be particularly relevant.

When identifying cost drivers, make sure to provide clear and objective definitions and refer to industry-acknowledged standards to facilitate acceptance of the process and the provision of data by bidders.

If you are unsure about any of them, use the consultation with internal stakeholders and/or the market to find out.

In addition to the cost drivers, you will also need to define the basic parameters for the LCC (evaluation period, discount rate, your electricity cost, etc.). Ask your internal stakeholders for this information.

Consult with relevant parties

It is important to involve and enter into dialogue with other departments of your organisation, suppliers and other stakeholders (such as building managers, maintenance staff, occupants).

Internal departments can help identify and prioritise cost drivers and define the parameters for the LCC calculations (i.e. usage patterns, appropriate discount rate, electricity cost and $CO_{2\text{-eq}}$ emissions from your energy contract if you include externalities, etc.).

Suppliers will be helpful in identifying the product types and solutions on the market to best meet your needs, compatibility and interoperability issues, and especially the type of information and standards available for the different cost drivers and parameters you want to consider in your procurement. Consulting with suppliers in advance also helps to ensure their acceptance of the use of LCC in the call for tenders.

Other stakeholders will be able to identify other concerns that might affect the lighting requirements in different zones and the most suitable lighting control systems.

Use all of this information in your decision process to select the type of solution you want, the criteria to consider and how LCC will be used in the tendering process.

Data needed from other units

Before using the LCC tool for procurement you must liaise with other departments or units within your organisation to gather all data needed for the LCC tool, as not all of it will be automatically available to you. In some cases, you may also need to consult other public sector bodies.

For example, if you are a government agency operating in a building managed by the central government, you might need to identify the person in charge of the electricity supply contract to obtain the information on the cost of electricity (to be able to calculate operational costs) and associated $CO_{2\text{-eq}}$ emissions of your electricity (if you plan to include the associated externalities in the LCC calculation).

Using LCC prior to tendering process

The LCC tool can be used at this stage to help you select the type of solution to purchase, by comparing different solutions using preliminary data gathered in the consultation process.

II. How to use LCC during the tendering process

If in your tendering process you plan to use life cycle costs instead of pure acquisition price to evaluate economic offers, state it clearly in the tender documents, provide the LCC Tool with the common parameters to ensure transparency, ask for the data that you need for the LCC calculations and make sure to provide clear definitions and standards to ensure the comparability of offers.

Reflect on what additional environmental criteria to include, to select the best solution, from an economic and environmental point of view.

Decide your LCC parameters and environmental criteria

The LCC Tool has been designed to allow you to consider different cost categories so that it can be used in different contracting arrangements and conditions.

At a preliminary stage, it is important to have the full costs picture for better planning. However, you do not need to include all these categories in the tendering process if there is a good reason to exclude them. Also depending on the type of contract you tender for, some costs parameters will not be relevant – for example if you tender for light as a service where the installation belongs to the contracted company, acquisition costs will not be relevant as such costs will be charged indirectly through the service fee.

Some parameters, such as energy consumption or durability, will be part of LCC and therefore, evaluated in the awarding phase. However, minimum performance levels (in lumen per watt for light sources and watt per square meter for lighting installations) should be defined in technical specifications to ensure that the acquired solutions are environmentally preferable from the start. This also applies to other criteria not part of the LCC that should be included in the tender documents (such as light colour temperature, packaging reduction, waste management during installations, etc.).

Data sources for indoor lighting criteria

Even though there are no GPP criteria for indoor lighting at the EU level, several Member States and EU-funded projects have defined green procurement criteria for this product category. Some are listed here, even though not all of them might be up to date given the rapid changes in the market:

- The Premium Light Pro Indoor Lighting guidelines (available in several EU languages, published in September 2017).
- The Danish Energy Agency guidelines (available in Danish, page updated in September 2017).
- The UK Government Buying Standards for lamps (published in September 2015).
- The Topten.eu Best products of Europe recommendations (published in November 2013).

Can we define other award criteria linked to energy consumption?

As indoor lighting is an energy-consuming product, operation costs based on energy consumption have been included in the LCC Tool. Energy consumption in usage will be included in the LCC and thus considered as part of the costs award criterion, so this should not be duplicated elsewhere in the award criteria.

However, it is perfectly possible to combine LCC with technical specifications which set minimum requirements for energy-efficiency. It is also possible to combine LCC with award criteria based on other aspects of environmental performance such as end-of-life considerations.

Should we consider CO_2 externalities in the LCC or as a separate award criterion?

The procurement directives make it clear that LCC can include costs of environmental externalities, as well as costs directly incurred by the owner or user. To do this, it must be possible to determine and verify the cost of the externality – and this is the case for $CO_{2\text{-eq}}$ emissions based on energy consumption.

You can choose whether to include the cost of $CO_{2\text{-eq}}$ emissions in the LCC, or whether to apply a separate award criterion for it.

If you choose to include them in the tool, the externality cost of $CO_{2\text{-eq}}$ emissions will have to be specified. At the EU level, a report for DG Transport on the "Update of the Handbook on External Costs of Transport" by Ricardo-AEA from 2014, they propose a central value of 90 EUR/tonne (in 2010 prices) from a range between 48-168 EUR. In some countries, the Government might provide other figures. Therefore, practitioners will need to specify the costs for the climate change externality making sure that the figure they use is in line with the requirements defined in article 68.2 of Directive 2014/24/EU on public procurement. In the tool, it is proposed to use 90 EUR/tonne $CO_{2\text{-eq}}$.

If you apply a separate award criterion based on $CO_{2\text{-eq}}$ emissions, you may assign a higher weighting to this than it would have had if considered within the LCC. This approach may make sense if you are particularly concerned about the climate impact of the solution you purchase.

Cost drivers included in the LCC tool and used to evaluate the economic offers in the contract award	Other aspects to include in the tender as technical specifications, award criteria or contract clauses
• Acquisition costs • Delivery and installation costs • Maintenance/service costs • Operation costs (Energy consumption) • Fees, taxes and other costs • Externalities ($CO_{2\text{-eq}}$ emissions linked to energy consumption) if so defined in the tender	• Service requirements (e.g. guarantees) • Technical specifications of the installations and products (colour temperature, maintenance and rendering, glare, etc.) • Minimum energy efficiency of the installation and luminaires (higher efficiency is evaluated as part of the LCC operation costs linked to energy consumption) • Other environmental criteria (such as minimum rated lifetime, luminaire power factors, etc.) • Packaging and end of life management, etc.

Note: Based on Directive 2012/19/EU on waste electrical and electronic equipment (WEEE), producers are responsible for financing the collection, treatment, recovery and environmentally sound disposal of electric and electronic waste. It is assumed that all products include, in their purchase price, those waste management costs and, therefore no end of life costs have been included in the tool.

Define it clearly in the tender documents

Be transparent on how you will evaluate the offer, especially on how the economic offer will be evaluated and then weighed against other award criteria. Inform bidders in the tender documents that you will evaluate the economic offer using a life-cycle costing approach and include the LCC tool to be transparent and simplify explanations. The tool should include the parameters defined by the contracting authority for the LCC calculations (section A).

For each parameter, define in the tender documents exactly what is included and, if relevant, what standard they have to comply with, to obtain comparable offers.

To facilitate data input in the tool, request bidders to present the appropriate information through the "Bidder response sheet" of the tool, making sure that, for each area or room in the project there is a column for the bidders to input their data.

Bidders have to provide all the required data in order to calculate LCC and be eligible for the award of the contract. Making suppliers aware of this as part of preliminary market engagement and in the tender documents is important for a successful tender.

Total Cost of Ownership in the procurement of light sources by Syddjurs (Denmark)

In 2015, the Municipality of Syddjurs acted as the lead procurer of lighting and electrical items on behalf of a regional procurement community (JYFI).

The procurement was structured as a full assortment procedure, in order to allow JYFI to have access to the suppliers' full range of products within the offered product categories, with a fixed discount price.

For the lighting part, bids were assessed according to estimated total costs of ownership (TCO) of a representative sample of products.

TCO figures are available for the products included in the product lists of contractors. This reveals the vast variation in lifetime costs of different technologies, allowing procurers to select with confidence despite higher upfront costs.

More information here.

Establish contract clauses

Include specific contract clauses in the tender documents to allow monitoring of compliance with the promised performance and to:

- Apply sanctions for non-compliance with the declared information to keep contractors accountable for their offer's performance; or if deemed suitable,
- Provide financial bonuses in case monitored results exceed those estimated in the offer.

How to consider quality and durability

Quality and durability of indoor lighting installations are key in their overall LCC, as they greatly influence maintenance costs.

For some elements specific international standards exist (e.g. IEC/EN 62031 for LED equipment for use in lighting and IEC/EN 62471 on performance testing). For others, standard references are not available, therefore you will have to accept other relevant industry testing procedures.

To mitigate risks, include specifications and contract clauses regarding minimum guarantee periods.

Evaluate offers

With the information provided in the bids, you can evaluate the economic offers based on the life cycle costs calculated with the LCC Tool.

Each bidder will complete the LCC tool with their information in the "Bidder response sheet" and the total LCC – i.e. considering all types of rooms and lighting systems included in the offer- will be calculated automatically.

The tool allows you to see the results graphically (in the "Graphic results" sheet) and you can use that tab to compare the results of up to 10 different offers.

Once you have the LCC results for each bid, you will need to calculate the cost score for each bid based on the cost award criterion weighting and formula indicated in the tender documents.

By combining this with the other award criteria established in the tender documents, you will be able to select the most economically advantageous tender.

Steps to complete and use the LCC Tool

1

Decide the cost categories to be included in the LCC and the offers' structure

The tool has been designed to include different cost categories and options. If for some of them, namely "other costs", you do not have the appropriate data, exclude them from the calculations. Also decide what energy data must be provided to evaluate operational costs due to energy consumption, what replacement costs will be used to evaluate maintenance costs and decide if you will include the environmental externalities or not. Based on those decisions, hide (don't delete) the unused cost categories.

2

Complete Section A (green box) of the LCC Tool with your parameters

The tool will use data provided by the bidder and parameters provided by you, the contracting authority, to calculate life cycle costs. Based on the cost categories decided, fill in section A of the "Inputs and Results" sheet of the tool with your parameters (e.g. evaluation period, discount rate, electricity costs, replacement costs, etc.). This will be the basis for the calculations and should be included in the tool provided in the tendering documents, to ensure transparency.

Make sure to protect all sheets of the tool except the "Bidder response sheet", so that bidders cannot tamper with them accidentally, but can still input their data in the appropriate cells and see their results.

3

Request bidders to complete the "Bidder response sheet" tab of the tool

In the tender documents, require bidders to present the appropriate information through the "Bidder response sheet" of the tool and to protect that sheet when sending their offers to ensure that no data manipulation can happen during the evaluation process.

The information in this sheet is linked to the "Input & Results sheet" so it is important to keep the provided structure to ensure the correct calculation of LCC results.

4

Use the LCC results to evaluate the cost award criterion

As different formulas and weightings are used by contracting authorities to evaluate costs, the LCC tool does not itself calculate a score for each tender – but provides the cost values to be included in this calculation. Calculate the cost score for each bid based on the LCC results and the cost award criterion weighting and formula indicated in the tender documents.

By combining this with the other award criteria established in the tender documents, you will be able to select the offer with the best overall results.

Tool functions overview

The LCC Tool contains six sheets, but the main one is the “LCC Inputs and Results” where the LCC parameters and information is compiled and results presented.

1. As a public authority, you have to complete section A - green box.

2. Brief explanations and recommendations are provided in pop-up comments to guide you on the information to be provided in each parameter included in the tool. Hover over the cell to read the comment.

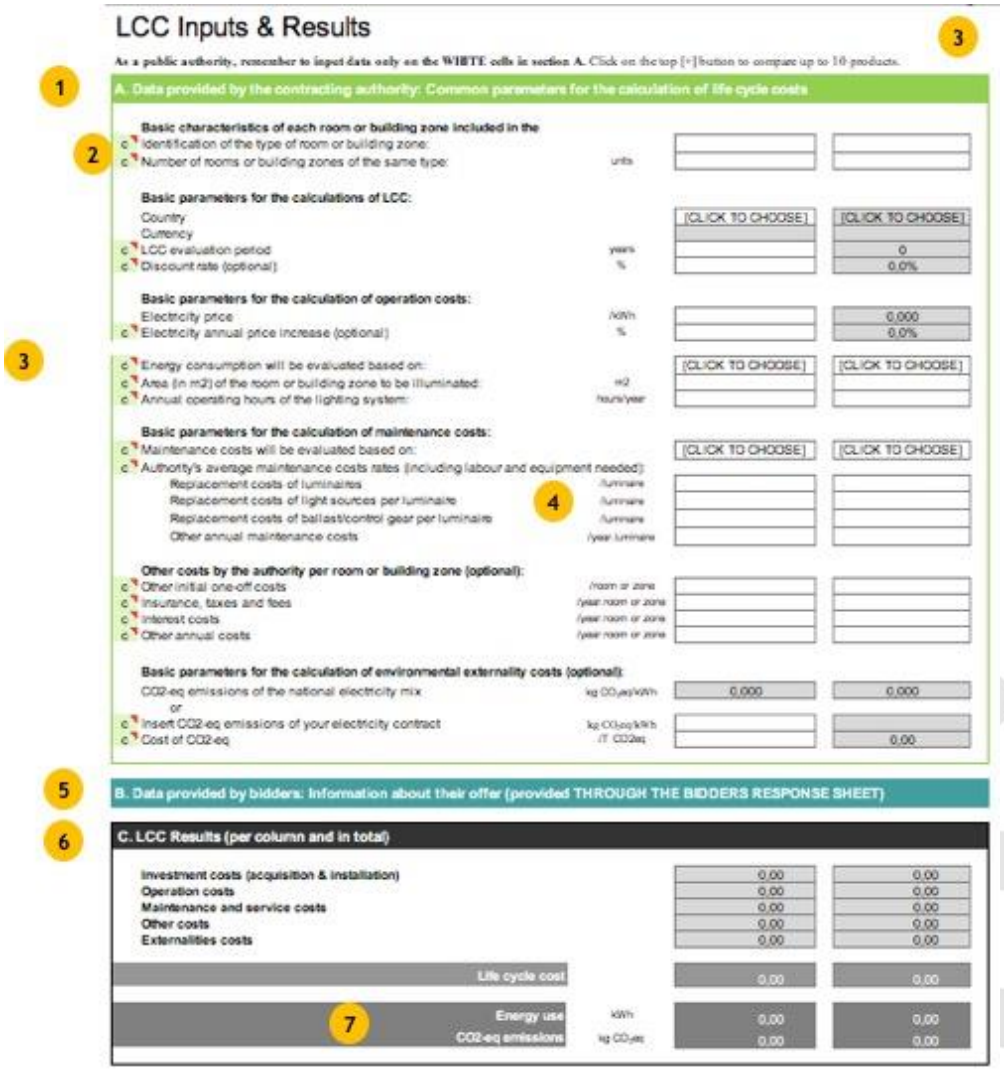
3. Click on the [+/-] sign at the top to show or hide more columns to describe different types of rooms or building areas in your project, and on the left to hide or show certain cost drivers and parameters.

4. Several cost drivers and parameters are foreseen in the tool which might or might not be relevant for your project. If irrelevant, hide the corresponding lines to avoid inputting data. Remember to also hide these from the “Bidder response sheet” to ensure coherence. This might be the case for maintenance (if for example, it is conducted by your own staff, or as part of an existing contract) or if you decide not to include the environmental externalities.

5. Data provided by bidders through the “Bidder response sheet” are automatically copied and shown in section B - turquoise box.
Click on the [+/-] sign to show or hide them.
Costs and other data to be provided by bidders require appropriate definitions in the tender documents to ensure comparability of offers. Make sure that these are properly included (e.g. the norm for the useful lifetime of the lamps or specific maintenance tasks).

6. LCC costs are presented in section C - black box - by cost category; and provided by type of room or building area as well as aggregated for the whole building.
The formulas used to calculate the final life cycle costs are explained in the “Definitions and Formulas” tab of the LCC tool. The graphic representation of results is provided in the "Graphic results" tab in the form of a bar chart showing the contribution of each cost category to the LCC results.

7. The tool also provides you with the estimated total energy consumption and $CO_{2\text{-eq}}$ emissions of each type of room or building area and for the whole building for the duration of the evaluation period.



III. After the tendering process

Monitor compliance with the tender requirements and performance levels promised by the contractor; apply sanctions or bonuses if appropriate; identify lessons for future tenders; communicate results to motivate internal acceptance and buy-in and promote replication by other stakeholders.

If LCC was part of the tender

Ensure that your contract explicitly mentions the performance levels included in the bidder response sheet as part of the terms. Monitor performance during contract management to ensure compliance with claims made by contractors – for example in relation to maintenance frequency and costs or the energy performance of equipment by testing them according to the standard defined in the tender specifications – and apply sanctions when non-compliance is found (in line with Article 70 of Directive 2014/24/EU on public procurement).

Use this stage to record relevant information for the next tender (e.g. if there was enough competition, if bidders provided all relevant information in the appropriate way, etc.). This will allow you to improve results in future similar calls for tenders.

If LCC was not included in the tender

If LCC was not used during the tendering process but you requested information for all relevant parameters (especially related to operation and service costs), use the LCC Tool to estimate the life cycle costs of the different offers – including the awarded one - and to compare between them and with the current situation, if data was identified in the preparatory stage. This will help you develop a baseline of data to inform contract management and future tenders.

Communicate results

Use all this information to communicate results and plan measures for future tenders. This is especially important if you changed the type of products acquired and the results can help to motivate acceptance, buy-in and further improvements.

If possible, share your experience (successes, drawbacks and lessons) with other authorities to encourage replication. One way to share your results at the European level is through the European Commission's collection of GPP Good Practices (like the example presented above) published regularly in the EC GPP News Alert.

Background and acknowledgments

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As set out in the Communication "Public Procurement for a Better Environment" (2008), the European Commission is encouraging public authorities to green their purchasing decisions. In this context, life cycle costing is considered as a useful tool that could deliver financial savings as well as reductions in the environmental impact of purchases made by public authorities.

The European Commission would like to facilitate the wide use of LCC by providing tools that can help the application of LCC among public authorities in the European Union and commissioned this work.

For its development, the project team has referred to other existing tools, guidelines and data sources, namely:

- Technical specifications of the Life cycle costing (LCC) calculation tool produced by Studio Fieschi & soci Srl and Scuola Superiore Sant'Anna for the European Commission DG-Environment, under service contract N°070201/2014/692192/SER/ENV.F.1 (July 2016).
- LCC-calculation for procurement of indoor lighting systems by the Swedish National Agency for Public Procurement (November 2016).
- Total Cost of Ownership tool for bulbs and lighting systems by the Danish Ministry of the Environment.
- LCC tool for indoor lighting by the Government of Flanders, Belgium (under development, for more information please contact Els Verwimp at els.verwimp@vlaanderen.be).
- For the CO_2eq emissions of national electricity mix: Thinkstep AG Environmental Footprint datasets –data developed in the framework of the Commission Environmental Footprint pilot phase (2013-2018) and valid until December 2020.

DG Environment