



Ministry of Environment , Climate  
Change and Technology

# USER GUIDE FOR INDOOR LIGHTS

Life Cycle Costing Assessment (LCCA)



Version 1.0

Promoting Energy Efficient Buildings through  
Strengthening Low Carbon Energy  
Island Strategies (LCEI) Project





**Ministry of Environment,  
Climate Change and Technology**

Strengthening Low Carbon Energy Island  
Strategies (LCEI) Project



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# Abbreviations

<b>CFL</b>	Compact fluorescent lamp
<b>CO<sub>2</sub> -eq</b>	Carbon Di-oxide equivalent
<b>DISCOM</b>	Electricity Distribution Company
<b>EE</b>	Energy Efficiency
<b>FTL</b>	Fluorescent Tube Lights
<b>kWh</b>	kilo watt hour
<b>LCC</b>	Life cycle cost
<b>LCCA</b>	Life cycle cost assessment
<b>LED Light</b>	Light-emitting diode

# 1. Introduction

This guide has been developed for the implementation of life cycle costing-based procurement as per the notification from the Ministry of Finance under the clause 10.77 of the 3<sup>rd</sup> Amendment (2020/R-51) to PFR 2017/R-20. The notification directs all the public procurers to undertake life cycle costing assessment to determine least lifecycle cost option during procurement of the prioritised appliances and equipment as per the procedure mentioned therein.

This user guide is developed for the procurement of Indoor lighting products, including LED (90 – 200 Lm/W), CFL (40 – 70 Lm/W) and FTL (50 – 90 Lm/W) for regular lighting needs.

The tool guide for Indoor Lighting Equipment facilitate the user on the following aspects:

1. Introduction to LCCA;
2. Objective, applicability and when to use the tool;
3. Preparation of the bid documents including the list of parameters and evaluation criteria to be included in the bid;
4. Definitions and formula for the bid evaluation;
5. Software requirement and compatibility to use the LCCA tool; and
6. Steps to use the LCCA Tool.

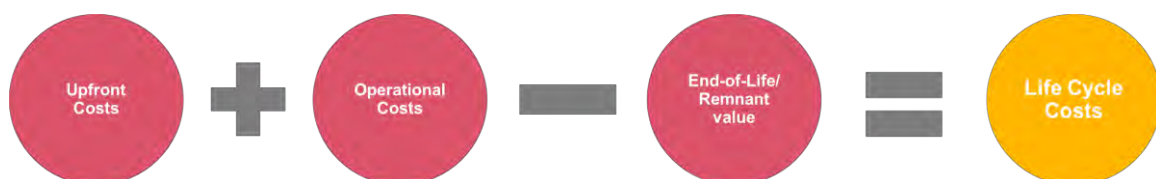
## 1.1. Life cycle cost assessment (LCCA)

***The lowest upfront cost (acquisition & installation) bid may not be the most economical bid over the life cycle of an equipment or appliance***

Life cycle costing-based procurement considers upfront costs (acquisition & installation), operational costs and end-of-life/remnant costs over the lifetime of a product with the objective to holistically assess the total cost of ownership of the product throughout its usable life.

Life-cycle cost assessment (LCCA) provides organisations the ability to determine their procurement expenses by holistically incorporating all lifecycle cost factors. LCCA enables organisations to determine the most cost-effective option among different competing alternatives to purchase, own, operate, maintain, and finally, dispose of a product.

*Figure 1: An overview of LCCA cost interactions*



The LCCA becomes critical in the scenario of energy efficiency, wherein organisations focus on procuring the highest efficiency products. Such products can often have higher upfront costs (acquisition & installation) which in turn can increase economic stress on the organisations' financial budget with moderate energy savings in the long run. The LCCA methodology analyses all the relevant costs including the upfront costs (acquisition + installations), operation costs (energy, service and maintenance costs) and end-of-life/remnant costs, to present the best economic procurement option with adequate emphasis on energy efficiency. In summary, the LCCA can help organisations move towards achieving a balance between economic and energy efficient options.

### 1.1.1. Upfront Cost (Acquisition and Installation)

Upfront costs include acquisition and installation costs related to a product. Cost for the acquisition of the product includes the price at which the product is bought incorporating all commissioning, freight, transport and taxes. Installation costs include other one-time costs such as the labour or technician costs to install the product.

### 1.1.2. Operational Costs

The operating cost is often the most critical cost component of the LCCA. The operational costs include costs towards operating the equipment, largely electricity costs in case of electrical equipment and Service/maintenance costs during the operational/useful life of a product. The electricity costs are the costs of electricity supply, all taxes and fees included (MVR/kWh) and serves to calculate operational costs linked to the energy consumption of the product. The operational costs also include Service/maintenance costs, which covers labour costs and the cost of any spare parts or replacements required during the operational/useful life of a product.

### 1.1.3. End-of-Life Costs

End-of life costs or remnant value is the depreciated value of the product at the end of its useful life. This value reduces the total life cycle cost as it assumes that the product could be sold at the end of the evaluation period. In case of some equipment (especially electronic equipment) and under certain regulations requiring regulated disposal of equipment, the end-of-life cost may increase the total life cycle cost.

## 1.2. What is the objective of the tool?

### ***Enable an economical and energy efficient procurement***

The objective of this tool is to assist the procurement officers and bid evaluators involved in public procurement activities in the Maldives, to determine the least cost products based on energy efficiency-based life cycle costing. The tool enables a balance between cost economics and energy efficiency, providing subsequent energy and cost savings for the organisations in the long run.

## 1.3. Who is this tool intended for?

The tool has been designed for the procurement officers and bid evaluators associated with the public sector organisations in the Maldives. The tool is designed with a user centric approach to promote anyone with basic spreadsheet experience of Microsoft Excel™ to be able to use it. The tool provides enough information as notes and definitions of various parameters for the user understanding and

ease of access. Further, there are no calculations at the user end barring basic data entry parameters. These data entry parameters will be included in the procurement documents and can be easily entered in the model with the reference of the bidder responses/proposals.

## 1.4. When to use the tool?

This tool can be used for the products following procurement methodology as per the LCCA. The tool can be used at different stages during the procurement process, as listed below:

### 1.4.1. Before bidding/Bid preparation

Before tendering and during bid preparation the tool can help the procuring entity in market assessment activity for various product options. The procuring entity through the tool can assess any preliminary product proposals for identifying different cost elements and define general performance requirements for the new products to be procured.

### 1.4.2. During bidding/Bid evaluation

During bidding and evaluation, the tool can be used to compare the offers received from bidders. The evaluator can compare the life cycle cost (LCC), energy utilisation and the estimated carbon footprint (CO<sub>2</sub> emissions) of different offers, during the evaluation phase.

### 1.4.3. After bidding/After bid award and finalisation

After the bidding process the procuring entity can use the tool to verify and evaluate the performance of the awarded solution. Comparative analysis can be conducted of the operations of the previous procurements to the current procurement. Further, post bidding the tool could be used to monitor the results and help set benchmarks for the future bids.

## 2. Preparation of the bid document

This user guide is developed for the procurement of Indoor lighting products, i.e. LED, CFL, FTLs installed inside buildings for regular lighting needs. In the bid document, under the “Statement of Requirement”, the procuring entity will provide specifications for the type of bulb and other parameters as listed in this section. The bid document will mention that the criteria for evaluation of the bids would be based on Life cycle cost assessment (LCCA).

### 2.1. Parameters to be provided in the bid document by procuring entity

The Table 1 lists the general LCCA parameters which will be provided by the procuring entity in the bid documents. These parameters have been fixed in the tool by default but can be changed by the procuring entity as per the process requirements.

*Table 1: Parameters to be provided by procuring entity in the bid document*

<b>Parameters fixed by Procuring entity for life cycle costing assessment</b>				
<b>Sr. No.</b>	<b>Parameter</b>	<b>Definition</b>	<b>Source of Data</b>	<b>Fixed value</b>
1.	Minimum/Maximum System Luminous Efficacy required [1]	The range of System Luminous Efficacy required by the procuring entity. It is the total luminous flux or lux emitted by the light source per unit lamp wattage. It is expressed in lumens per watt (Lm/W).	Procuring entity	LED: 90 – 200 Lm/W [2] CFL: 40 – 70 Lm/W [3] FTL: 50 – 90 Lm/W [3]
2.	Minimum luminous flux required	It is the total amount of light emitted by a light source in any direction. It is measured in lumens.	Procuring entity	Calculated value (Maximum wattage multiplied by the Luminous efficacy)
3.	Maximum Burning Hours	Useful rated lifetime also referred to as service lifetime-of the light sources (in hours) after which they are to be replaced in order to guarantee	Procuring entity	LED: 50,000 [2] CFL: 10,000 [3] FTL: 20,000 [3]

<sup>1</sup> The range selected is as per the commercially available technologies in the market and can be updated in the future as per expert advice.

<sup>2</sup> Development Finance International - <https://www.dfintl.com/wp-content/uploads/2016/04/LED-Road-Lighting-Design-Manual1.pdf>

<sup>3</sup> BEE - <https://beeindia.gov.in/sites/default/files/Building%20Lighting%20Design%20Tip%20Sheet.pdf>



Parameters fixed by Procuring entity for life cycle costing assessment				
Sr. No.	Parameter	Definition	Source of Data	Fixed value
		the minimum lighting quality of the installation.		
4.	Operational office days per year	Total number of working days for the office.	Procuring entity	250 <sup>[4]</sup>
5.	Daily office hours	Total number of daily working hours for the office.	Procuring entity	8 <sup>[4]</sup>
6.	Assumed utilisation during office hours	Estimated duration in a day (hours) when the light equipment will be utilised.	Procuring entity should provide this value in the bid documents as per the requirement	8 hours per day <sup>[4]</sup>
7.	Assumed utilisation after office hours	Estimated duration, post office hours when the light equipment will be utilised.	Procuring entity should provide this value in the bid documents as per the requirement	2 hours per day <sup>[4]</sup>
8.	Assumed utilisation during non-working (off/leaves/holiday) days	Estimated duration for the utilisation of the equipment when offices are closed for work.	Procuring entity should provide this value in the bid documents as per the requirement	Nil <sup>[4]</sup>
9.	Life of the Equipment	Number of years over which to calculate and compare life cycle costs of different solutions.  The upper limit for the life of a luminaire is set as 10 years.	Procuring entity	Calculated value ('Maximum Burning Hours' divided by the estimated 'Total annual operating hours')

<sup>4</sup> The value is considered as a conservative assumption for the particular LCCA based procurement.

Parameters fixed by Procuring entity for life cycle costing assessment				
Sr. No.	Parameter	Definition	Source of Data	Fixed value
10.	Discount rate	The discount rate is used to calculate the present value of future costs.	Procuring entity	5% <sup>[4]</sup>
11.	Electricity annual price increase (optional)	Annual average rate of price increase of electricity in the Maldives. It should include all non-recoverable taxes and fees and be adjusted to eliminate the effect of inflation.	Procuring entity/ Electricity utility/ Distribution Company (DISCOM)	2% <sup>[4]</sup>
12.	CO <sub>2</sub> -eq emissions of the national electricity mix	Grid emission factor	Procuring entity	0.72 <sup>[5]</sup>

The Table 2 lists the bid specific parameters to be provided in the bid documents by the Procuring Entity:

*Table 2: Bid specific parameters to be provided by the procuring entity*

Bid Specific Parameters to be provided by the Procuring Entity			
Sr. No.	Parameter	Definition	Source of Data
1.	Number of luminaires	Number of luminaires required.	Procuring entity should provide this value in the bid documents as per the requirement.
2.	Maximum wattage	Required power consumption (watt) of the luminaire.	Procuring entity should provide this value in the bid documents as per the requirement.
3.	Electricity price	Cost of electricity supply, all taxes and fees included (MVR/kWh). It serves to calculate operation costs linked to the energy consumption of the Indoor Lighting Equipment.	The procuring entity should use the highest electricity consumption band for Government/Institutions set by the Utility Regulatory Authority (URA).  If the procuring entity is based in the Greater Male' Region, then the applicable tariff will be from the Greater Male' Region and if the

<sup>5</sup> UNFCCC:

[https://www4.unfccc.int/sites/SubmissionsStaging/NationalReports/Documents/29357641\\_Maldives-BUR1-1-First%20BUR%20of%20Maldives.pdf](https://www4.unfccc.int/sites/SubmissionsStaging/NationalReports/Documents/29357641_Maldives-BUR1-1-First%20BUR%20of%20Maldives.pdf)

<b>Bid Specific Parameters to be provided by the Procuring Entity</b>			
<b>Sr. No.</b>	<b>Parameter</b>	<b>Definition</b>	<b>Source of Data</b>
			procuring entity is based in the outer islands, then the tariff applicable for that particular region should be used. For example: If the procuring entity is based in the Greater Male' Region, then the electricity tariff of the highest defined electricity consumption band (electricity consumption >600 kWh) under the 'Government & Institutes' consumer category will be applicable and currently it is MVR 4.35/kWh.

## 2.2. Bidder input parameters

The following set of parameters will be requested from the bidders in the bid document for the evaluation of bids. Please note the following parameters will be entered into the tool by the procuring entity with the data provided in the bidder's proposal:

*Table 3: Parameters to be provided by the bidder and entered by the Procuring entity*

<b>Parameters to be provided by the bidder and entered by the Procuring entity</b>			
<b>Sr. No.</b>	<b>Parameter</b>	<b>Definition</b>	<b>Source of Data</b>
1.	Bidder's Name	Name of the bidding entity.	Bidder
2.	Manufacturer details	Name of the indoor lighting equipment manufacturer.	Bidder
3.	Indoor Lighting Equipment Type and Model Number	Type and model of the indoor lighting equipment.	Bidder
4.	Luminaire power (wattage)	Power consumption (watt) of the luminaire including all operating, standby and any other losses.	Product specification sheet
5.	System Luminous Efficacy	The total luminous flux or lux emitted by the light source per unit lamp wattage, expressed in lumens per watt (Lm/W).	Product specification sheet
6.	Maximum Burning Hours	Useful rated lifetime also referred to as service lifetime- of the light sources (in hours) after which they are to be replaced in order to	Product specification sheet

Parameters to be provided by the bidder and entered by the Procuring entity			
Sr. No.	Parameter	Definition	Source of Data
		guarantee the minimum lighting quality of the installation.	
7.	Acquisition and installation cost (MVR/luminaire)	Acquisition and installation cost of the luminaire, including all elements and components.	Bidder

### 2.3. Documents to be submitted by Bidder

The following documents shall be requested to be submitted by the bidder for verification of information provided for LCCA.

1. Declaration of conformance as provided in section 7.
2. Product catalogue including product model number.
3. Signed and sealed 'Bidder technical details submission form' refer section 6.4.

### 2.4. Evaluation criteria

The following criteria shall be included in the bid document by the Procuring Entity. The bid evaluation criteria will be based on the least cost bid/offer identified by the life cycle costing formula, as provided below:

Life cycle costs = Upfront cost + (Electricity costs)<sub>NPV</sub>

Where,

- *Upfront Costs = (Acquisition costs + Installation costs) X Number of luminaires*
- *(Electricity Costs)<sub>NPV</sub> = Annual electricity consumption X Electricity Price X Electricity Present Value Factor X Number of luminaires*
- *NPV refers to Net Present Value, calculated by the following formula:*
  - *Net Present Value Factor = 1 / (1+Discount rate) ^ (Life of the Equipment)*

**Sample format to be used in the bid document is provided in section 6.**

# 3. Bid Evaluation Parameters

The Procuring Entity should consider the following definitions and formula for the bid evaluation.

## 3.1. Data provided by the Bidder

The following set of metrics are provided by the bidder as a part of their response to the bid.

### Metrics for the economic offer for the bid

The following metrics cover the economic costs of the product as defined in the bid and quoted by the bidders:

#### A. Luminaire acquisition and installation cost

Cost of luminaires, including all elements and components (light sources, ballast, built-in control devices), including the cost of installation, if any.

#### B. Maximum Burning Hours

Useful rated lifetime also referred to as service lifetime of the light sources (in hours) after which they are to be replaced in order to guarantee the minimum lighting quality of the installation.

### Metrics for the Electricity consumption of the Indoor Lighting Equipment

The following metrics govern the parameters for electricity consumption:

#### A. Luminaire power (wattage)

Power consumption (watt) of the luminaire including all operating, standby and any other losses.

## 3.2. Data provided by the Procuring entity

### Identification of the Equipment

#### A. Type of Indoor Lighting Equipment

Dropdown menu to select the type of the Indoor Lighting Equipment that will be evaluated in the tool. For e.g., if the quotations have been invited for LED based Indoor Lighting Equipment then in the tool please select LED from the dropdown list in the tool.

#### B. Number of Indoor luminaires to be provided

Number of luminaires to be delivered/installed by bidders as defined in the bid documents.

### **C. Minimum/Maximum System Luminous Efficacy required**

The range of System Luminous Efficacy required by the procuring entity. It is the total luminous flux or lux emitted by the light source per unit lamp wattage. It is expressed in lumens per watt (Lm/W).

### **D. Minimum luminous flux required**

It is the total amount of light emitted by a light source in any direction. It is measured in lumens.

### **E. Maximum Burning Hours**

Useful rated lifetime also referred to as service lifetime- of the light sources (in hours) after which they are to be replaced in order to guarantee the minimum lighting quality of the installation.

## **Basic parameters for the calculations of LCCA**

### **A. Life of the Equipment**

Number of years over which to calculate and compare life cycle costs of different solutions. The upper limit for the life of a luminaire is set as 10 years.

### **B. Discount rate**

Coefficient used to transform future cost into present value. This is called discounting and consists of applying a selected discount rate such that each future cost occurred during the evaluation period is adjusted and expressed in relation to the present time. The following present value factors are evaluated based on discount rate:

$$\text{Electricity Present value Factor} = 1 / (\text{discount rate} - \text{electricity price increase}) \times [1 - ((1 + \text{electricity price increase}) / (1 + \text{Discount rate})) ^ (\text{Life of the Equipment})]$$

$$\text{General Present value Factor} = 1 / \text{discount rate} \times [1 - (1 / (1 + \text{Discount rate})) ^ (\text{Life of the Equipment})]$$

## **Basic parameters for the calculation of operation costs**

### **A. Electricity price**

Cost of electricity supply, all taxes and fees included (MVR/kWh). It serves to calculate operation costs linked to the electricity consumption of the equipment. The per unit electricity costs/tariffs can be obtained from the Electricity utility/Distribution Company (DISCOM).

### **B. Electricity annual price increase**

Average price increase of electricity in the region of procuring entity.

### 3.3. Tool Result metrics

The following metrics depict the results of the bid evaluation:

#### Standalone metrics

##### A. Upfront costs (acquisition & installation)

Acquisition and installation costs of each type of installation.

$$\text{Upfront Costs} = (\text{Acquisition costs} + \text{Installation costs}) \times \text{Number of luminaires}$$

##### B. Electricity Costs

Cumulative annual cost due to the electricity use of each type of installation during the evaluation period expressed in net present value.

$$\text{Electricity Costs} = \text{Annual electricity consumption} \times \text{Electricity Price} \times \text{Electricity Present Value Factor} \times \text{Number of luminaires}$$

##### C. Electricity use

Electricity use of the installation during the evaluation period (kWh) calculated based on the annual electricity consumption.

$$\text{Electricity use during product life} = \text{Annual Electricity Consumption} \times \text{Life of the Equipment} \times \text{Number of luminaires}$$

##### D. CO<sub>2</sub>-eq emissions

CO<sub>2</sub> Emissions associated with the operations or usage of the installation (per each room or zone type).

$$\text{CO}_2 \text{ eq emissions} = \text{CO}_2 \text{ eq emissions of the national electricity mix} \times \text{Electricity use during product life}$$

##### E. Life cycle cost

Total costs including upfront and electricity costs estimated over the evaluation period. Electricity costs are calculated in net present value.

$$\text{Life cycle costs} = \text{Upfront Costs} + (\text{Electricity costs})_{NPV}$$

### Comparative metrics depicting best option

#### **A. Reference Electricity Saving in comparison to least Acquisition cost Indoor Lighting Equipment**

Highlights Electricity savings compared to the procurement option with the lowest acquisition costs.

$$\text{Reference Electricity Saving} = \text{Electricity consumption of least acquisition cost product} - \text{Electricity consumption of least LCC product}$$

#### **B. Reference Electricity Saving costs in comparison to least Acquisition cost Indoor Lighting Equipment**

Highlights Electricity savings costs compared to the procurement option with the lowest acquisition costs.

$$\text{Reference Electricity Saving Costs} = \text{Electricity consumption costs of least acquisition cost product} - \text{Electricity consumption costs of least LCC product}$$

#### **C. Reference Carbon Emissions reduced in comparison to least Acquisition cost Indoor Lighting Equipment**

Highlights carbon emission reductions compared to the procurement option with the lowest acquisition costs.

$$\text{Reference carbon emission reductions} = \text{Carbon emission reductions of least acquisition cost product} - \text{carbon emission reductions of least LCC product}$$



# 4. LCCA Evaluation Tool

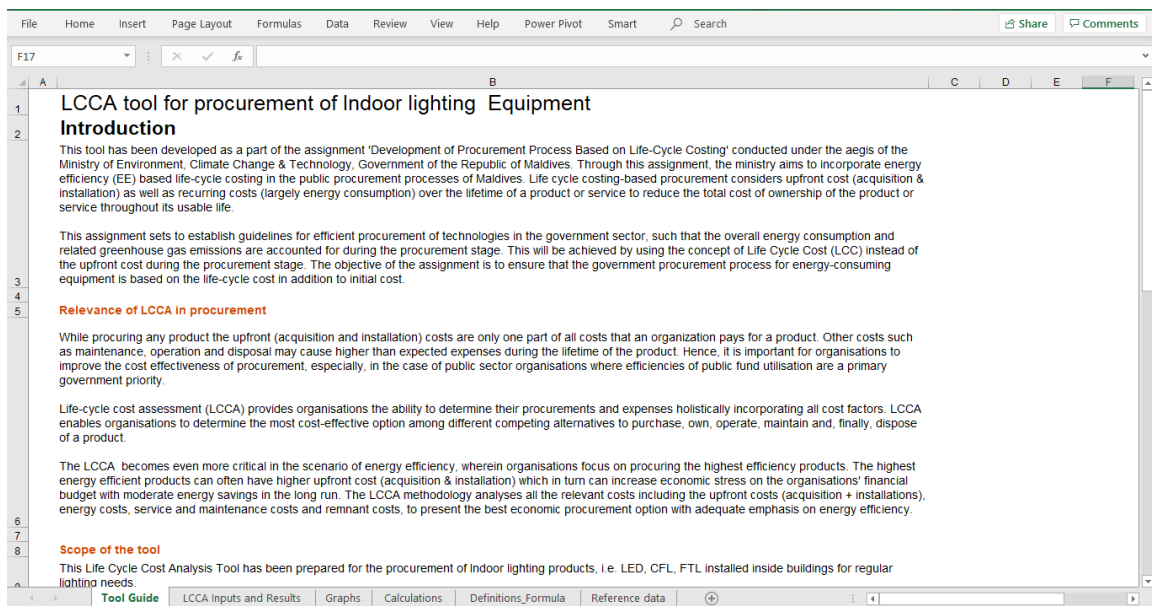
The following sections highlight points on the usage of the LCCA evaluation tool.

## 4.1. Software requirement and compatibility

The tool is originally developed on Microsoft Excel™ - a spreadsheet-based tool. Please use the following steps to access the tool:

1. Ensure that the Microsoft Excel™ is available on your computer system.
2. Download the tool files (e.g., Indoor Lighting Equipment\_Tool.xlsx) from the authorised source.
3. Save a copy of the tool files to the desired location on your Computer.
4. Navigate to the saved location and double click to open the tool. The following window should appear -

*Figure 2: A snapshot of the tool upon installation*



## 4.2. Structure of the tool

The tool contains six tabs or sub-sheets:

1. **Tool Guide** briefly outlines the guidelines to operate the tool. The tool guide covers the introduction to the assignment, relevance of LCCA in procurement, scope of the tool, structure of the tool and how to use the tool.

2. **LCCA inputs & results**, where the LCCA parameters and information are compiled and results are presented. The LCCA results are presented for each product offered. The procurement agency will only interact with this sheet for any data inputs. There is provision to add up to 15 different products for LCCA.
3. **Graphs**, this sheet provides a graphical representation of the LCCA results in the form of bar charts. One analysis in this sheet shows the contribution of each cost category to the total LCC of each type of product included in the tool. Another analysis shows a comparison between the least LCC product and least upfront cost (Acquisition + Installation) product, analysing both the products in terms of costs, electricity use and CO<sub>2</sub> -eq. emissions.
4. **Calculations**, this sheet shows the calculations needed to transform all present and future costs to net present value. Separate calculations have been made for the Electricity costs.
5. **Definitions & formulas**, this sheet provides definitions for each parameter and formula used in the tool. Procurement authorities will have to make sure to specify in the bid documents the standards and data format to ensure consistency between offers (especially in relation to energy use for the calculation of operation costs).
6. **Reference data**, blank sheet to store any temporary data.

**NOTE:** The tool needs to keep its precise structure for the formulas and calculations to work. Therefore, it is important to ensure that:

- i. Do not edit the worksheet structure.
- ii. Do not edit formula/delete cells/ rows/ columns. If you do not require data in certain fields, you can hide the unnecessary rows/columns. You can do it by using the [+/-] signs on the left and top margins or in the Format menu.
- iii. Do not add cells/ rows/ columns.
- iv. Input data only in the intended fields.

# 5. Steps to complete and use the LCCA Tool

Organizations using this tool for the procurement should follow the instructions given below while preparing their bid documents.

## 5.1. How to use the tool

1. The procuring entity must only interact with the "LCCA Inputs and Results" sheet for all the data inputs.
2. The Procuring entity, must only fill the **white cells** in **section A** and **Section B** of the "LCCA Inputs and Results" tab. The **Dark Grey** cells are calculated automatically based on information from other cells and tabs.
3. All the data entry is to be done by the Procuring entity. The data for **section A** will be provided by the bidder and should be asked in the bid documents. The **section B** data is to be determined by the Procuring entity.

Figure 3: Representation of the LCCA Inputs and Results Sheet

The screenshot shows a Microsoft Excel spreadsheet titled "LCCA Inputs & Results". The spreadsheet is divided into several sections:

- Section A: Data provided by the Bidder.** Rows 5 to 14. This section includes "General Details" such as Bidder's Name, Manufacturer, Voltage, System Luminous Efficacy, Luminous Flux, and Maximum Burning Hours. It also includes "Acquisition & Installation cost parameters" like Acquisition and Installation cost.
- Section B: Data provided by the procuring entity.** Rows 17 to 48. This section includes "Reference of the equipment type in tender" (Type of Lighting equipment, Number of luminaires to be procured), "Basic parameters for the calculations of LCC" (LCCA evaluation period, Discount rate), "Basic parameters for the calculation of Operational costs" (Electricity price, Electricity annual price increase), and "Operating hours" (Operational office days per year, Daily office hours, After office hours, Assumed utilization during office hours, Assumed utilization after office hours, Assumed utilization during non-working days, Total annual operating hours).

The spreadsheet shows multiple columns for different bidder options (A, B, C, D, E) and calculated values. Some cells are highlighted in dark grey, indicating they are calculated automatically.

4. The cells have different colour codes for every interaction:

Colour Coding	Description
	The white cells are the input cells for data entry. Please enter relevant values in these cells. Comments are given on the left column in the sheets for guidance.
	The dark grey cells are automatically filled/calculated with data from previously filled cells or are formula based. Please do not edit/alter these cells.
	The light grey cells can be altered by the procuring entity but remain constant for a particular procurement. Certain standard values have been locked in these cells.
	The comment cells on the left column against input fields provide comments and notes for clarity. The procuring entity can refer the text in these cells to know more about the input parameter or result.

5. In the 'comment cell' next to input fields, explanations are provided for the inputs. Detailed information is provided in the "Definitions & Formulas" tab defining the formula and definitions.
6. The section 'C' and Section 'D' of the LCCA Inputs and results sheet, provide results and best procurement option respectively. The details on the output section are given in section 5.2. The following result parameters are available:
  - i. Life Cycle Cost (LCC) of the product
  - ii. Electricity consumption in kWh
  - iii. Cost of electricity consumption in MVR
  - iv. The best option on the basis of least LCC
  - v. CO<sub>2</sub>-eq emissions during the product life
  - vi. Electricity Saving (kWh): Least upfront cost product vs Least LCC product
  - vii. Electricity Saving costs (MVR): Least upfront cost product vs Least LCC product
  - viii. Carbon Emissions reduced: Least upfront cost product vs Least LCC product
7. The 'Graph' sheet represents the results and comparative analysis in a bar graph format. The following analysis are covered:

- i. LCCA Results: Covers the representation of consolidated products in terms of costs, energy consumed and carbon emissions.
- ii. Least LCC product vs Least upfront cost (acquisition + installation) product: Presents a comparative analysis of the Lowest LCCA Bid and Lowest Upfront (acquisition + installation) cost bid in terms of costs, energy consumption and carbon emissions.

## 5.2. Results structure of the tool

The results are presented in the 'LCCA Inputs and Results' sheet with deep dive analysis on product cost trends in 'Graphs' sheet.

### 5.2.1. LCCA Inputs and Results

The section 'c' of the sheet summarises all the cost factors such as upfront costs and electricity costs post calculations during the evaluation period in present net value. The section presents LCCA costs of the procurement with respect to product/bidder with the lowest cost highlighted in **Yellow**. The section also highlights Electricity use during the product life and CO<sub>2</sub>-eq emissions during the product life.

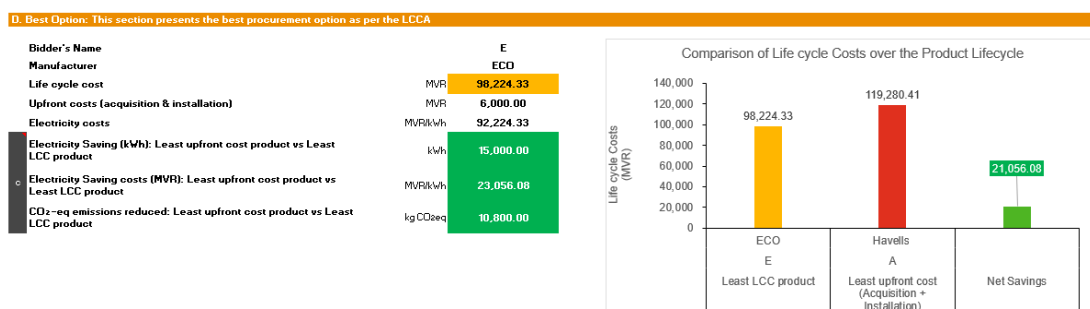
Figure 4: Representation of the section C: LCCA Results

C. LCCA Results (per type of Equipment and in total): This section presents the LCCA results across the products						
Upfront costs (acquisition & installation)	MVR	4,000.00	5,000.00	5,200.00	5,500.00	6,000.00
Electricity costs	MVR	115,280.41	134,493.81	96,067.01	96,067.01	92,224.33
<b>Life cycle cost</b>	<b>MVR</b>	<b>119,280.41</b>	<b>139,493.81</b>	<b>101,267.01</b>	<b>101,567.01</b>	<b>98,224.33</b>
Electricity use during the product life	kWh	75,000.00	87,500.00	62,500.00	62,500.00	60,000.00
CO <sub>2</sub> -eq emissions during the product life	kg CO <sub>2</sub> eq	54,000.00	63,000.00	45,000.00	45,000.00	43,200.00

The section 'D' of the sheet presents the best procurement option as per the LCCA methodology with three comparative factors:

- i. **Electricity Saving (kWh):** Least upfront cost (acquisition & installation) product vs Least LCC product
- ii. **Electricity Saving costs (MVR):** Least upfront cost (acquisition & installation) product vs Least LCC product
- iii. **Carbon Emissions reduced:** Least upfront cost (acquisition & installation) product vs Least LCC product

Figure 5: Representation of the section D: Best Option

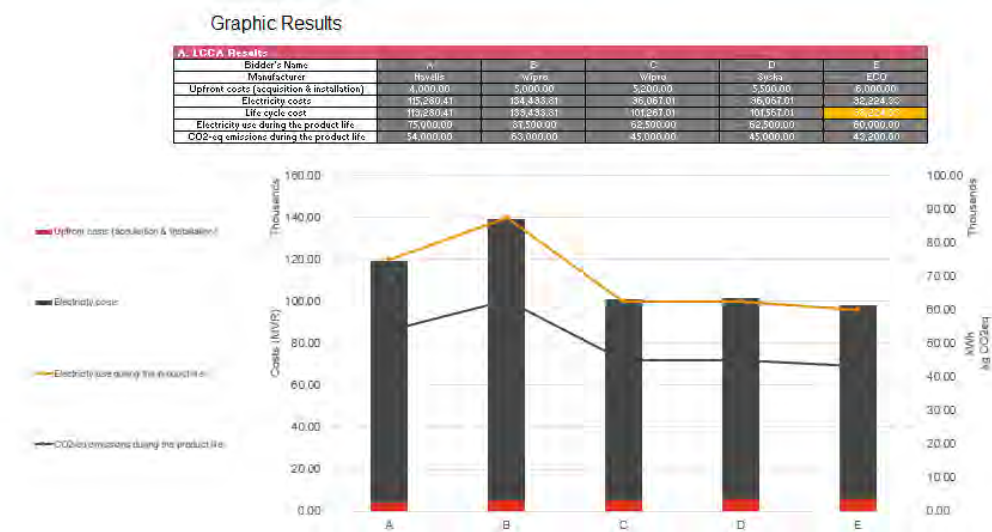


## 5.2.2. Graphs

The graphs sheet represents the tool results in graphical format. The sheet is segregated into two sections, section A: LCCA Results and section B: Least LCC product vs Least upfront cost (Acquisition + Installation) product comparison.

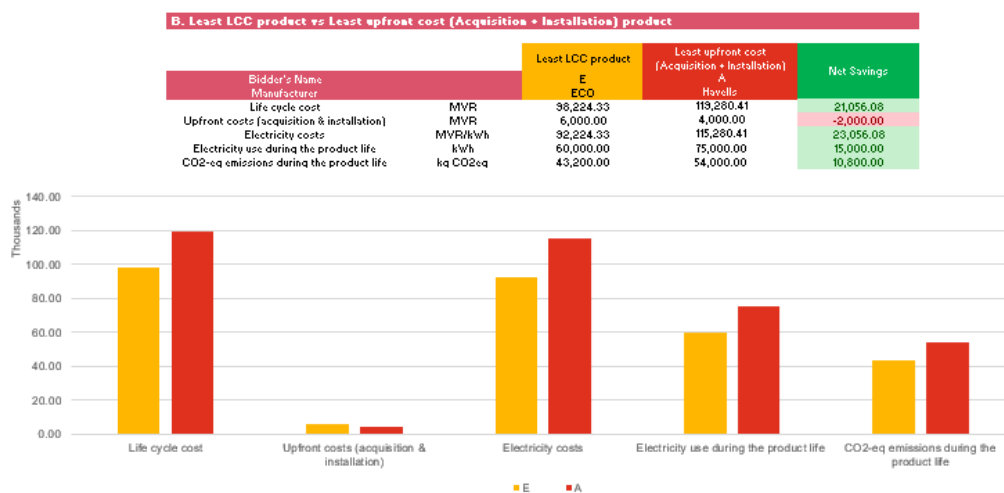
Section A summarises the costs parameters and plots all the results on a bar graph format. The left Y (Vertical) axis in the graph represents the costs in Thousand MVR and the right Y (Vertical) axis in the graph represents the Electricity use and CO<sub>2</sub>-eq emissions during the product life as depicted in Figure 6: Representation of the section A: LCCA Results.

Figure 6: Representation of the section A: LCCA Results



Section B presents a comparative analysis between least LCC product vs least upfront cost (acquisition + installation) product, analysing both the bids in terms of costs, electricity use and CO<sub>2</sub>-eq emissions. The section also presents net savings (see column) between both the bids marking **Green** for savings and **Red** for losses.

Figure 7: Representation of the section B: Least LCC product vs Least upfront cost (Acquisition + Installation) product



# 6. Annex 1 – Sample formats to be used in bid document

The procuring entity should include the sections 6.1, 6.2, 6.3 and 6.4 as part of the bid documents.

## 6.1. Statement of requirement

The products applicable under the program are LED (90 – 200 Lm/W), CFL (40 – 70 Lm/W) and FTL (50 – 90 Lm/W) for regular lighting needs.

1.	Type of Lighting equipment to be procured	[provided by procurement entity]
2.	Maximum Wattage	[provided by procurement entity]
3.	Number of luminaires to be procured	[provided by procurement entity]

## 6.2. Evaluation Parameters

The following parameters are fixed for the life-cycle costing assessment

Sr. No.	Parameter	Definition	Fixed value
1.	Minimum/Maximum System Luminous Efficacy required [6]	Minimum System luminous efficacy required by the procuring entity. It is the total luminous flux or lux emitted by the light source per unit lamp wattage. It is expressed in lumens per watt (Lm/W).	LED: 90 – 200 Lm/W [7] CFL: 40 – 70 Lm/W [8] FTL: 50 – 90 Lm/W [3]
2.	Minimum luminous flux required	It is the total amount of light emitted by a light source in any direction. It is measured in lumens.	Calculated value (Maximum wattage multiplied by the Luminous efficacy)
3.	Maximum Burning Hours	Useful rated lifetime also referred to as service lifetime- of the light sources (in hours) after which they are to be replaced in order to guarantee the	LED: 50,000 [2] CFL: 10,000 [3] FTL: 20,000 [3]

<sup>6</sup> The range selected is as per the commercially available technologies in the market and can be updated in the future as per expert advice.

<sup>7</sup> Development Finance International - <https://www.dfintl.com/wp-content/uploads/2016/04/LED-Road-Lighting-Design-Manual1.pdf>

<sup>8</sup> BEE - <https://beeindia.gov.in/sites/default/files/Building%20Lighting%20Design%20Tip%20Sheet.pdf>

Sr. No.	Parameter	Definition	Fixed value
		minimum lighting quality of the installation.	
4.	Life of the Equipment	Number of years over which to calculate and compare life cycle costs of different solutions. The upper limit for the life of a luminaire is set as 10 years.	Calculated value ('Maximum Burning Hours' divided by the estimated 'Total annual operating hours')
5.	Discount rate	The discount rate is used to calculate the present value of future costs.	5% <sup>[4]</sup>
6.	Electricity annual price increase	Annual average rate of price increase of electricity in the Maldives. It should include all non-recoverable taxes and fees and be adjusted to eliminate the effect of inflation.	2% <sup>[4]</sup>
7.	CO <sub>2</sub> -eq emissions of the national electricity mix	Grid emission factor.	0.72 <sup>[9]</sup>
8.	Electricity price	Cost of electricity supply, all taxes and fees included (MVR/kWh). It serves to calculate operation costs linked to the energy consumption of the Indoor Lighting Equipment.	[provided by procurement entity]

### 6.3. Evaluation Criteria

The bid evaluation criteria will be based on the least cost bid/offer identified by the life cycle costing formula, as provided below:

$$\text{Life cycle costs} = \text{Upfront cost} + (\text{Electricity costs})_{NPV}$$

Where,

- *Upfront Costs = (Acquisition costs + Installation costs) X Number of luminaires*
- *(Electricity Costs)<sub>NPV</sub> = Annual electricity consumption X Electricity Price X Electricity Present Value Factor X Number of luminaires*
- *NPV refers to Net Present Value, calculated by the following formula:*

<sup>9</sup> UNFCCC: [https://www4.unfccc.int/sites/SubmissionsStaging/NationalReports/Documents/29357641\\_Maldives-BUR1-1-First%20BUR%20of%20Maldives.pdf](https://www4.unfccc.int/sites/SubmissionsStaging/NationalReports/Documents/29357641_Maldives-BUR1-1-First%20BUR%20of%20Maldives.pdf)



- Net Present Value Factor =  $1 / (1 + \text{Discount rate})^{\text{Life of the Equipment}}$

## 6.4. Bidder technical details submission form

This form should be filled and submitted by the bidder. No changes should be made to the format.

Sr. No.	Parameter	Value
1.	Bidder's Name	
2.	Manufacturer details	
3.	Indoor Lighting Equipment Type and Model Number	
4.	Luminaire power (wattage) Power consumption (watt) of the luminaire including all operating, standby and any other losses.	
5.	System Luminous Efficacy The total luminous flux or lux emitted by the light source per unit lamp wattage, expressed in lumens per watt (Lm/W).	
6.	Maximum Burning Hours Useful rated lifetime also referred to as service lifetime- of the light sources (in hours) after which they are to be replaced in order to guarantee the minimum lighting quality of the installation.	
7.	Acquisition and installation cost (MVR/luminaire) Acquisition and installation cost of the luminaire, including all elements and components.	

The following documents must be submitted by the bidder while submitting the bid response:

1. Declaration of conformance as provided in section 7.
2. Product catalogue including product model number.
3. Signed and sealed 'Bidder technical details submission form' refer section 6.4.

# 7. Annex 2 – Declaration of conformance

(This declaration letter for conformance is to be submitted by the Bidder along with the Proposal).

Date:

Place:

[Address of the procuring entity]

Dear Madam/Sir,

Sub: Invitation of Request for Proposal for providing \_\_\_\_\_

We hereby confirm the following:

1. The Proposal is being submitted by \_\_\_\_\_ (Name of the Bidder) who is the Bidder in accordance with the conditions stipulated in the RfP.
2. We have examined in detail and have understood and abide by; all the terms and conditions stipulated in the RfP document issued by \_\_\_\_\_ (Name of procuring entity) and in any subsequent communication sent by \_\_\_\_\_ (Name of procuring entity).
3. The product information provided against this procurement is as per the requirements of the RfP document and standards mentioned therein to the best of our knowledge and as per the original specification provided by the manufacturer.
4. We would be solely responsible for any errors or omissions in our Proposal.

For and on behalf of :

Signature :

(Authorised Signatory)

Name of the Person :

Designation :