

Smart Light Concepts

Decision Support Tool 1.2 USER MANUAL

User manual for the decision support tool 1.2. The pilot partners should use the instruction manual to guide them on how to use the decision support tool and they will be supported by PP3. This new version of the tool and test instruction should be used for testing by all pilot partners and the feedback questionnaire should be completed. **The feedback from the questionnaire will be used to complete the deliverable “Report of the use of decision support tool 1.1” for all pilot partners.**

[Watch VIDEO MANUAL](#)

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1. INTRODUCTION

The adoption of energy efficient lighting technologies by municipalities has been undergoing technological transformation as a way to reduce harmful emissions, energy consumption and as a facilitator of sustainable smart city goals. Currently, energy efficient lighting systems that reduce energy consumption also meet these important features are hindered by several barriers such as initial setup cost, policies and regulations, knowledge about the technologies and the lack of an established minimum quality standard.

2. PURPOSE OF THE SLIC DST

The SLIC DST is a web-based application designed to support users in making decisions on the adoption of innovative technologies and techniques for energy savings, low-carbon technologies and renewable energy use in smart cities. The tool integrates the economic, environmental, social and technical sustainability aspects (Figure 1) of public lighting in different surroundings (urban, rural, industrial, nature, historical site and business). The tool consists of a user interface that allows for computational analysis which combines these sustainability dimensions along with the preference of each individual user. The analysis provides outputs (lighting options) highlighting the cost and impact of each dimension. According to the score of each option, the best solution is selected. This tool can also be useful for calculating the expected energy use, light performance, and lifecycle cost of street lighting upgrades for the areas which are defined in the SLIC project.

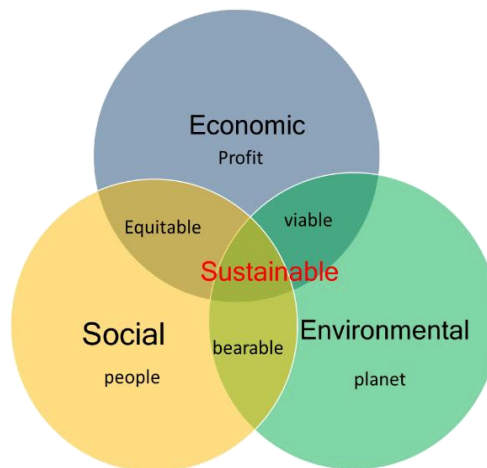


Figure 1: Sustainability Dimensions

- **Economic dimension:** The economic dimension measures the following KPIs; operating costs, capital/investment costs, cost savings, and energy savings was agreed to be acceptable to be implemented in the tool.
- **Environmental dimension:** Environmental indicators considered relate to resource depletion and CO2 emissions.
- **Social dimension:** Some of the social indicators that were agreed are health and safety, user comfort, the impact of road traffic accidents and its relationship to illuminance levels - motorists and pedestrians, crime risk, and acceptability and pride and social inclusion which can be promoted by light colour, and light design believed to promote a sense of pride.

3. WEB-BASED DST:USER MANUAL

This user manual describes the testing and validation carried out in cooperation with the project pilot partners. The results of the testing and validation of the decision support tool 1.1 has supported the modification of the decision support tool 1.1 to an improved version 1.2 and the test instruction has been adjusted accordingly. This new version of the tool and test instruction will be used for testing by all pilot partners.

It is important to read this technical manual before using the tool. The tool is written in Java and ready to be run from a PC but can be accessed from a mobile phone. Running the tool is achieved through an interaction with a user-friendly Interface. The user interface contains a series of drop-down menus and toolbars to allow the user to implement several tasks. These tasks are:

- Input and modify parameter values
- Define baseline, upgrade and alternative scenarios
- Modify inputs
- Run the impact analysis
- View and save the results

The rest of this document describes the DST interface, and dependencies required to run the tool and the general menu navigation, inputs requirements of the tool and how to enter the inputs, description on how to run the tool and how to extract the results in readable formats. This manual is organised as follows.

- General information of system
- System overview
- Steps for system functions
- Authorised use of the DST
- Points of contact
- Acronyms & abbreviations
- Appendix

3.1.General information of system

Browser Requirements

The recommended browser to use for best user experience is [Google Chrome](#).

Required Inputs

Downloadable CSV files containing the formats for the DST inputs are provided in Tool Information, step 6-lighting system and step 7-design lighting scenarios. These files can be downloaded, filled and uploaded into the tool in the step 6-lighting system or step 7-design lighting scenarios of the DST. A description about how the tool works and information about the downloadable templates can be found in the Tool Information and also available in the sidebar under TECHNICAL INFORMATION.

Save or Print results

To view, save or print the calculation result in pdf format, you need to have a PDF viewer installed.

3.2. System overview

The overview of the DST in Figure 2 shows a general flow of SLIC DST. After entering the URL address of the web application, the user can reach the dashboard. In the dashboard, if a user wants to proceed to the main application page then he needs to provide user information (name, email and organisation). After successfully submitting required user information, the main tool window with input requirements opens (Tool version, location specification, system inputs

and designing scenarios). Note that if the inputs are not given properly, scenario and calculation will not work thereby prompting an error. The system will notify the user to enter the missing inputs.

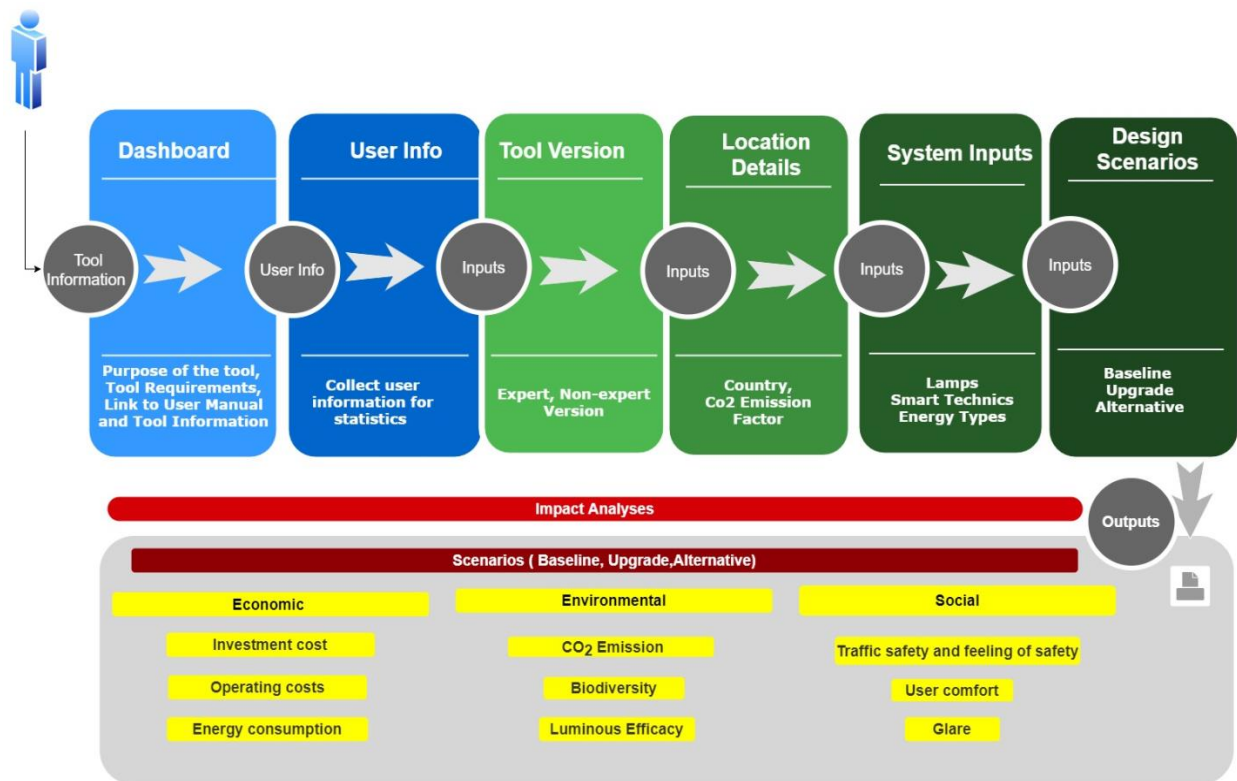


Figure 2: DST overview

Once input collection is complete, the user can go to step 7 - design lighting scenarios to build the scenarios. In the scenario population step, the user will define the specific inputs for each scenario accordingly. The user can leave empty the options in this part (e.g. no dimming option in baseline scenarios or different lamp specification in baseline and upgrade scenarios). In this case, the system will assume empty lighting technics or specifications will not be applied in the selected scenario. After scenario specifications are selected and scenarios are built, the user can proceed to impact analysis for the defined scenarios. Once impact analysis is finished, the results will be shown. Also, the results can be saved as a Pdf or printed out. The steps for using this tool have been described in details in steps for system functions.

3.3. Steps for system functions

The steps of system functions are as follows:

1. Dashboard
2. User information
3. End User specification
4. Location specification
5. General inputs
6. Lighting system inputs
7. Designing lighting scenarios
8. Impact analysis
9. Outputs

3.3.1. Step 1: Dashboard

The SLIC DST Dashboard shown in Figure 3 provides an overview of the DST including information about the browser information, required inputs and technical terms used in the tool. The technical terms used in this tool can be found in the sidebar in the knowledge library. For optimal user experience, please use google chrome. Information on how to run the tool and the type of inputs required to run the tool are all provided in the tool information under technical information. The tool information page provides a detailed description of how to run the tool and the type of inputs required.

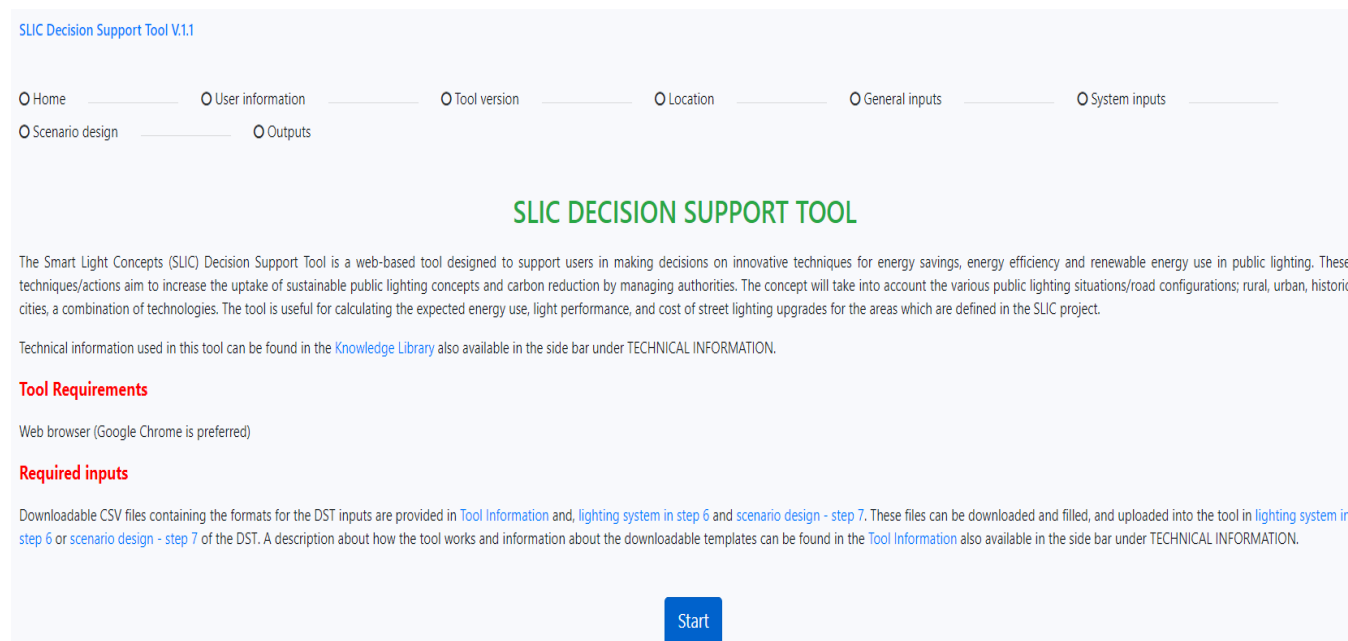


Figure 3: Dashboard

Sidebar

In the sidebar, you will find the steps and functionalities of this tool. This has been divided into categories which are Home, Interface and Extras.

1. Home shown in Figure 4 contains the Dashboard and the page where User Information is collected.

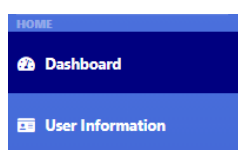


Figure 4: Home

2. Interface in Figure 5 is divided into Inputs, Building scenarios and Outputs.



Figure 5: Interface

- a. Inputs collects data of a lighting system and end-user specification (tool version). These inputs are used to build the scenarios previously described and to determine the user category which is divided into expert and non-expert. ***This is a crucial step for the calculation and generation of results in the tool and must not be missed.**
 - b. In the building scenario, the 3 scenarios are designed based on the inputs collected or by importing data.
 - c. In the Outputs, impact analysis of the 3 scenarios is presented in tabular and graphical forms.
3. Extras (Figure 6) contains the Technical information and a how-to-use guide for the DST. Feedback contains the pilot partner validation questionnaire and lastly, contact us, FAQs and the user manual are in Help.

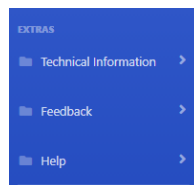


Figure 6: Extras

3.3.2. Step 2: User information.

Clicking the start button initialises the tool. This takes you to the page where user information is collected (Figure 7). Information collected includes the category of user accessing the tool. If you do not wish for your information to be saved and if you do not wish to be contacted for feedback, please leave this box unchecked.

USER INFORMATION

First Name*

Last Name*

E-mail Address*

Affiliation/Company *

User Type*

I agree that my information can be stored and I may be contacted in the future.

By clicking "Submit", I have read the [Privacy Policy](#) and I agree to the terms and conditions.

Submit

Figure 7: User information

3.3.3. Step 3: End User specification

This information will be used to classify the user based on lighting expertise and direct the tool according to the user group.

Available end-user groups for the tool are Non-expert and Expert - Figure 8.

1. For non-expert users, the tool is dependent on data publicly available such as lamp information available on lighting manufacturers websites. We also collect data from SLIC pilot partners.
2. For expert users, it is assumed that the user is able to provide technical data required to run the tool.

***If no user group is selected, the expert version will be automatically set as the default when both the expert and non-expert user groups versions are available.**

END USER SPECIFICATION

*If no version is selected, expert version will be the default version

End User Specification Non-Expert version Expert version

Submit

Figure 8: End User Specification

3.3.4. Step 4: Location specification

This current version of the tool requires the user's lighting location information to collect country specific emission conversion factor. This can also be edited if the default value is not up to date (Figure 9).

Figure 9: Location specification

3.3.5. Step 5: General Inputs

This step has been skipped as it is currently under development.

This tab gathers inputs specific to the road geometry, light geometry and required lighting levels (minimum illuminance and luminance standard). These inputs are used to provide the tool with the basic road layout to be analysed. If any of the parameter values are blank, the tool will be unable to perform the calculations.

3.3.6. Step 6: Lighting System Inputs

The tool collects data about lamp details, technics details such as cost of dimming or sensor equipment (in the case of new installation) or maintenance cost. This step is optional and contains downloadable csv templates that can be used to collect data and upload to the tool. A CSV file is an excel file extension type. The other option for providing data will be explained in step 7 - designing scenarios.

For this step, default information already existing in the tool can be used and this can be updated or deleted (Figure 10).

Data provided has to be correct to have accurate cost, savings and impact calculations. Also, provided inputs are validated, therefore giving the wrong type of data as input will not be allowed by default.

Figure 10: Lighting system inputs

The input collection in this step is divided into three stages:

- Lamps:** Figure 11 shows information collected about the luminaire operating cost and investment cost, luminaire power. The current version of the tool contains generic lamps which can be updated or deleted. Note that a lamp's power includes fixture and luminaire power. If you prefer to add more lamps to the existing lamp list, you should use the add button. Alternatively, you can download the CSV template and gather the required inputs and upload it back into the tool (you can upload up to a maximum of 10 files). Note that the format of the template must not be changed or altered. Additional texts must not be entered or new cells created.

Please select lamps to build scenarios

*Note that Power(W) includes both the fixture and luminaire. Fixture details can also be imported as a csv file

<input type="checkbox"/>	Type	Manufacturer	Power (W)	Equipment Cost (€)	Installation Cost (€)	Maintenance Cost (€)	Update
<input type="checkbox"/>	HPS	Generic	70.0	150.0	50.0	16	<input type="button" value="update"/>
<input type="checkbox"/>	HPS	Generic	115.0	150.0	50.0	16	<input type="button" value="update"/>
<input type="checkbox"/>	HPS	Generic	130.0	150.0	50.0	16	<input type="button" value="update"/>
<input type="checkbox"/>	HPS	Generic	189.0	150.0	50.0	16	<input type="button" value="update"/>
<input type="checkbox"/>	HPS	Generic	150.0	150.0	50.0	16	<input type="button" value="update"/>
<input type="checkbox"/>	HPS	Generic	183.0	150.0	50.0	16	<input type="button" value="update"/>
<input type="checkbox"/>	HPS	Generic	188.0	150.0	50.0	16	<input type="button" value="update"/>
<input type="checkbox"/>	HPS	Generic	310.0	150.0	50.0	16	<input type="button" value="update"/>
<input type="checkbox"/>	HPS	Generic	289.0	150.0	50.0	16	<input type="button" value="update"/>
<input type="checkbox"/>	HPS	Generic	250.0	150.0	50.0	16	<input type="button" value="update"/>
<input type="checkbox"/>	HPS	Generic	297.0	150.0	50.0	16	<input type="button" value="update"/>
<input type="checkbox"/>	HPS	Generic	400.0	150.0	50.0	16	<input type="button" value="update"/>
<input type="checkbox"/>	HPS	Generic	465.0	150.0	50.0	16	<input type="button" value="update"/>

+

Figure 11: Lamp details for configuring scenarios

- Technics:** The tool collects data about costs of the smart techniques used in the lighting system (Figure 12). You can download the CSV template and gather the required inputs and upload it back into the tool (maximum of 10 files). Note that the format of the template must not be changed or altered. Additional texts must not be entered or new cells created.

Please select technics to build scenarios.

*Technic details can be uploaded as a csv file using downloadable csv as a template.

<input type="checkbox"/>	Type	Name	Equipment Cost (€)	Installation Cost (€)	Maintenance Cost (€)	Update
<input type="checkbox"/>	Sensor	Motion Sensor	0.0	0.0	0.0	<input checked="" type="checkbox"/> update
<input type="checkbox"/>	Dimmer	Dimmer	0.0	0.0	0.0	<input checked="" type="checkbox"/> update

+

Figure 12: Technics details for configuring scenarios

- Energy:** Here, data about costs of the energy equipment used in the lighting system and price of energy (Kwh) is collected (Figure 13). Data collected include costs of procuring and installing energy harvesting modules for solar energy or other equipment costs associated with energy provision for the lighting system. You can download the CSV template and gather the required inputs and upload it back into the tool (maximum of 10 files). Note that the format of the template must not be changed or altered. Additional texts must not be entered or new cells created.

Please select energy source to add to scenarios.

*Energy source details can be uploaded as a csv file using downloadable csv as a template.

<input type="checkbox"/>	Type	Name	Battery Cost (€)	Energy Cost (€)	Equipment Cost (€)	Installation Cost (€)	Maintenance Cost (€)	Inflation Rate (%)	Update
<input type="checkbox"/>	Solar	British gas	10.0	12.0	30.0	10.0	60.0	0.0	<input checked="" type="checkbox"/> update
<input type="checkbox"/>	Gas	SSE	30.0	20.0	90.0	10.0	20.0	0.0	<input checked="" type="checkbox"/> update

+

Figure 13: Energy details for configuring scenarios

3.3.7. Step 7: Designing Lighting Scenarios

The design of the scenarios is based on the information obtained from the pilot partners and the existing literature/documents on low carbon public lighting. The scenarios aim to select the best-performing combination of fixtures and components to meet the needs of the pilot partners. To develop an initial set of possible scenarios, a combination of strategies and actions will be considered along with additional information provided by the pilot partners.

a. Description of the Scenarios considered in the DST

The tool considers three scenarios: Baseline, Upgrade and Alternative scenarios. The **Baseline scenario** describes the current situation. The **Upgrade scenario** describes the situation after implementation of energy saving lighting technologies. The **Alternative scenario** provides an alternative lighting scenario based on optimisation. This scenario is generated based on an optimisation algorithm that takes into account the importance level of each sustainability dimension (economic, environmental and social). Computational analysis provides a set of options (lighting options) with their costs and impacts of each dimension. A key feature of this tool is the ability to compare the scenarios.

In this step, you can build your lighting scenarios with input saved from the previous step. Alternatively, you can upload scenario based CSV files.

If step 6 - [lighting system inputs](#) is skipped, lighting system data must be provided in step 7 - [design lighting scenarios](#) . The inputs collected in step 6 are used in this step. To provide data for building the scenarios, CSV templates can be downloaded for each scenario below.

b. Building scenarios using data saved from lighting system inputs in step 6

To start building the scenarios, you must define the number of lamps, energy details and applied technics required for each scenario (Figure 14). These steps are described below.

- **Fixtures** - here, you can set the total number of lamps for all the scenarios. This is now sent to each scenario and you will see that under required lamps. The lamps required are calculated based on given inputs in the Fixture details screen, in this screen for each scenario the number of fixtures and number of lamps for each fixture is collected. Consequently, required lamps are calculated as multiplication of number of fixtures and number of lamps per fixture which will be shown in Required Lamps in Figure 17.
- **Technics** - technics that have previously been saved can be selected and added to the scenarios. The technics are divided into two categories, which are existing and new. Existing shows already exist in the system, while new shows the planned new technic installations.
- **Lamps** - here, lamps required for each scenario can be built and specific lamp details can be defined. All the lamps sent to the scenarios will be listed in the lamps table. From this list, the user can pick relevant lamps for the scenarios and the total number of lamps selected and added for each scenario is shown in Total lamps in Figure 17.

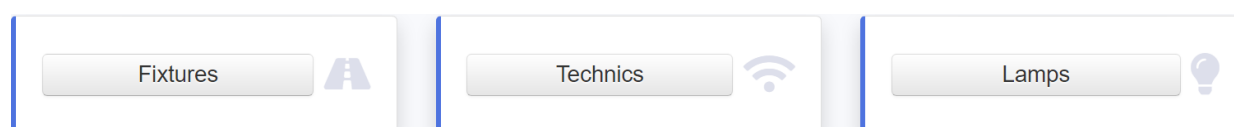


Figure 14: Building scenarios

Select lamps to build the scenarios ✕

Lamp Info	Choose lamp for scenario
Generic HPS 70.0 W	<input type="button" value="Generic"/>
Generic HPS 115.0 W	<input type="button" value="Generic"/>
Generic HPS 130.0 W	<input type="button" value="Generic"/>
Generic HPS 189.0 W	<input type="button" value="Generic"/>
Generic HPS 150.0 W	<input type="button" value="Generic"/>
Generic HPS 183.0 W	<input type="button" value="Generic"/>
Generic HPS 188.0 W	<input type="button" value="Generic"/>
Generic HPS 310.0 W	<input type="button" value="Generic"/>
Generic HPS 289.0 W	<input type="button" value="Generic"/>
Generic HPS 250.0 W	<input type="button" value="Generic"/>
Generic HPS 297.0 W	<input type="button" value="Generic"/>
Generic HPS 400.0 W	<input type="button" value="Generic"/>
Generic HPS 465.0 W	<input type="button" value="Generic"/>

Figure 15: Lamps list selected from step 6

Figure 15 shows the list of lamps selected that can be added to scenarios. When the user selects a lamp from the list, Lamp Info screen (Figure 16) will be shown. In this screen, the user can specify the lamp features for each scenario. For example, if the user does not want to have a lamp in baseline but in Alternative then the number of the lamps for the baseline can be set as '0'.

Lamp Info ✕

Baseline

Type and Watt	HPS 130.0
Energy Type:	<input type="text" value="British gas"/>
Dimming %	<input type="text" value="0.0"/>
Dimming Hours(Per year)	<input type="text" value="0"/>
Number of the Lamps	<input type="text" value="0"/>
Operating Hours(per year)	<input type="text" value="0.0"/>

Upgrade

Type and Watt	HPS 130.0
Energy Type:	<input type="text" value="British gas"/>
Dimming %	<input type="text" value="0.0"/>
Dimming Hours(Per year)	<input type="text" value="0"/>
Number of the Lamps	<input type="text" value="0"/>
Operating Hours(per year)	<input type="text" value="0.0"/>

Alternative

Type and Watt	HPS 130.0
Energy Type:	<input type="text" value="British gas"/>
Dimming (Min %)	<input type="text" value="0"/>
Dimming (Max %)	<input type="text" value="0"/>
Dimming Hours(Per year)	<input type="text" value="0"/>
Number of the Lamps	<input type="text" value="0"/>
Operating Hours(per year)	<input type="text" value="0.0"/>

Figure 16: Add lamps to scenarios

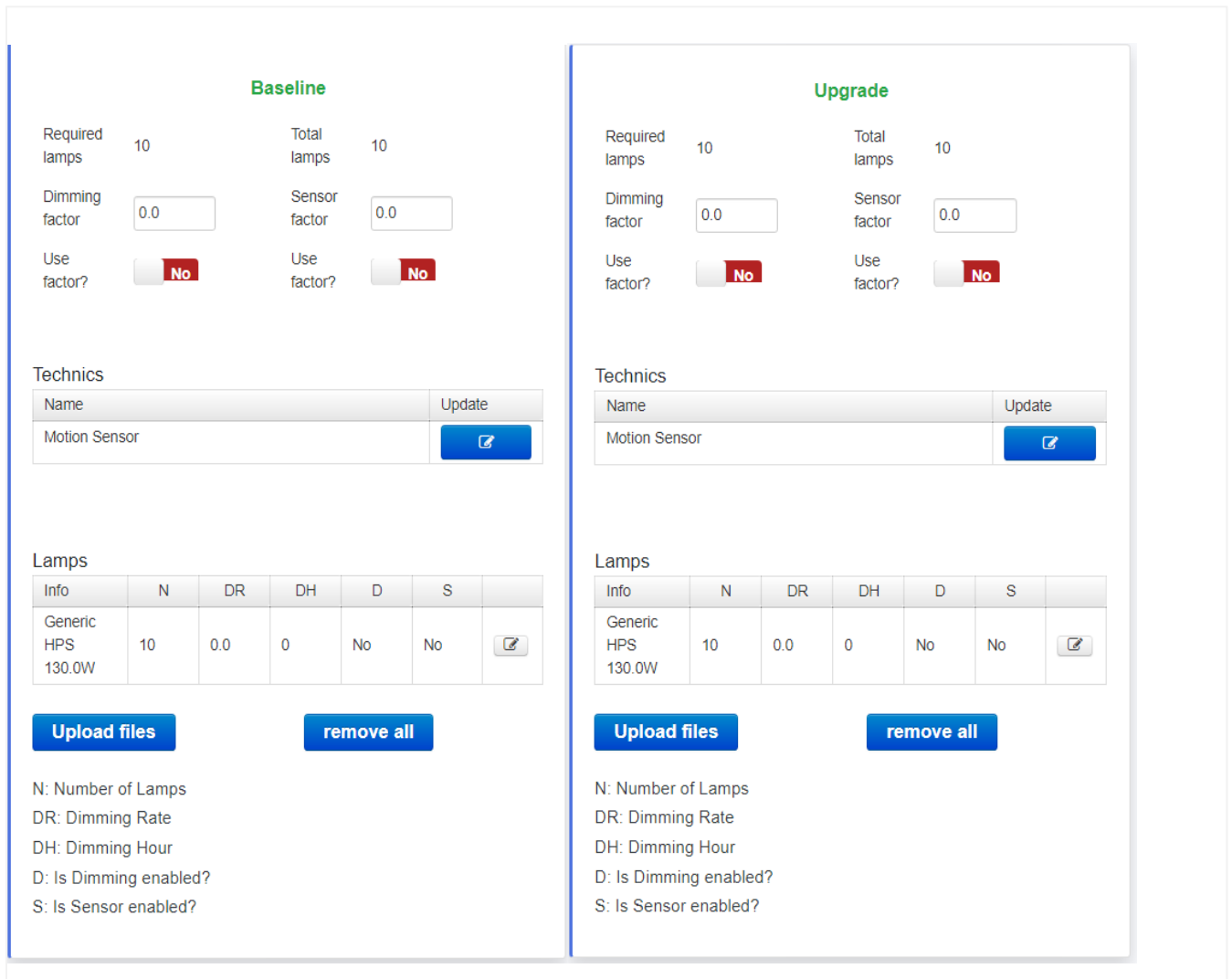


Figure 17: Overview of designed scenarios

In Figure 17, the configuration for each scenario can be viewed. The selected lamps from lamps list and technics will be shown for each scenario. These can be updated using the update button.

- **Dimming and sensor correction factors -**

These factors are used when you do not provide dimming rate – which is the percentage of dimming per lamp. These factors are reduction factors for energy consumption when using dimming or sensors or a combination of both. This is highly customisable according to the lamp.

c. Building scenarios by uploading scenario specific csv files.

CSV templates for the scenarios can be downloaded at the top of this page or in tool information. These templates cannot be altered otherwise; it cannot be read. Additionally, after collecting the inputs, each csv will need to be uploaded under its specific scenario. In addition, you can remove all the lamps in a scenario and upload new lamps.

3.3.8. Step 8: Impact Analysis

Once all inputs have been provided, the impact analysis for these scenarios are calculated on pressing the impact analysis button (Figure 18). Note that for this version, only data for the lighting systems in the defined scenarios are included in the calculations. If any input is missing, the tool will not run and you will be prompted with an error message.

Impact analysis

Figure 18: Impact analysis

3.3.9. Step 9: Outputs

In this step, the tool provides the results for the scenarios. The results provided in this tool provides a high level overview of the costs and impacts of the scenarios in respect to the lighting systems. The output addresses three sustainability dimensions – Economic, Environmental and Social (Figure 19). The outputs can be printed for each dimension using the print button.



Figure 19: Result categories

The tool uses the inputs related to the fixture’s light output, energy use, and costs to perform analysis of how each fixture will perform on a specific road type. In this step, calculation results are divided to sub costs in the well formatted table. In addition, this tool has the added functionality to allow the user to view the details of the created scenarios by clicking the see details button for the corresponding scenario.

The scenario results are shown in a table comparing the costs and savings between the scenarios (see Figure 20). Additionally, the cost saving comparisons are visualised in a bar chart ([results summary](#)) for a comparison of the costs and impacts of the scenarios. Also, the results can be printed or saved in PDF format ([print - figure 20](#)). To update the input details to create/change a new scenario, click the ‘back’ button ([back](#)) to go to the previous screen to update the scenario details. Lastly, the details of the created scenarios can be viewed by clicking see details ([Pop-up to see scenario input details](#)) button for corresponding scenario which opens a pop-up screen. The financial toolbox is also printed under the economic results tab ([financial toolbox](#)).

Economic Result Summary

Alternative Result Details

Financial Toolbox

Economic

Environmental

Social

Back

Economic Result Summary

Alternative Result Details

Financial Toolbox

Print

Costs				
	Unit	Baseline	Upgrade	Alternative
Total Cost	£	3726.7	3726.7	2393.5
Lamp Maintenance	£	166.7	166.7	166.7
Lamp Installation	£	500	500	500
Lamp Equipment	£	1500	1500	1500
Technic Maintenance	£	0	0	0
Technic Installation	£	0	0	0
Technic Equipment	£	0	0	0
Energy Consumption	kWh	130	130	18.9
Energy	£	1560	1560	226.8

Savings (%)			
	Upgrade-Baseline	Alternative-Baseline	Alternative-Upgrade
Total Saving	0	35.8	35.8
Lamp Maintenance	0	0	0
Lamp Installation	0	0	0
Lamp Equipment	0	0	0
Technic Maintenance	◆	◆	◆
Technic Installation	◆	◆	◆
Technic Equipment	◆	◆	◆
Energy Consumption	0	85.5	85.5
Energy	0	85.5	85.5

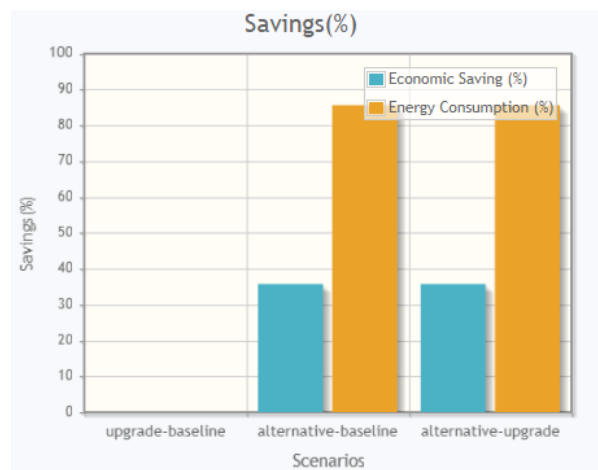


Figure 20: Results summary

4. AUTHORISED USE OF DST

The SLIC DST 1.2 is authorised for use by the SLIC project partners only.

5. POINTS OF CONTACT

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