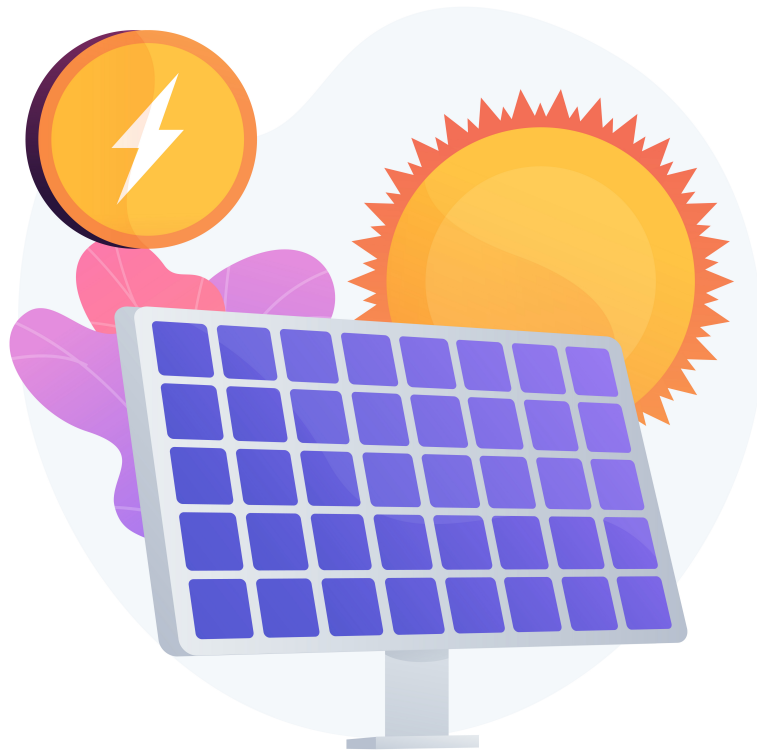


Financial Assessment Tool for Electrification User Manual

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Financial Assessment Tool for Electrification (FATE)
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Nomenclature

Technical abbreviations

<i>AC</i>	Alternating Current
<i>DC</i>	Direct Current
<i>kVA</i>	Kilo Volt-Ampere
<i>kW</i>	Kilo Watt
<i>kWh</i>	Kilo Watthour
<i>kWp</i>	Kilo Watt peak
<i>LV</i>	Low Voltage
<i>MV</i>	Medium Voltage
<i>PV</i>	Photovoltaics
<i>SHS</i>	Solar Home System

Financial abbreviations

<i>CapEx</i>	Capital Expenditure
<i>DCF</i>	Discounted Cash Flows
<i>FATE</i>	Financial Assessment Tool for Electrification
<i>IRR</i>	Internal Rate of Return
<i>KPI</i>	Key Performance Indicators
<i>LCOE</i>	Levelized Cost of Energy (or Electricity)
<i>NGN</i>	Nigerian Naira
<i>NPV</i>	Net Present Value
<i>OpEx</i>	Operational Expenditure
<i>PAYG</i>	Pay As You Go
<i>ROI</i>	Return on Investment
<i>WACC</i>	Weighted Average Cost of Capital

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1 Introduction

FATE (Financial Analysis Tool for Electrification) was developed as part of the PeopleSuN project (People Power: Optimizing Off-Grid Electricity Supply Systems in Nigeria) to provide a financial estimation of off-grid electrification projects.



Figure 1: PeopleSuN project team in front of the solar facility at Dakwa PHC Health Center (2019)

The FATE is designed to establish the financial viability of mini-grid and solar home system (SHS) projects in rural areas of Nigeria. This tool is addressed to companies, project developers, financiers, and policymakers.

This tool was specially adapted for electrification plans of rural villages in Nigeria, where mini-grids and solar home systems are affordable solutions for the population. Within this context, the tool estimates the financial feasibility of electrification projects for rural villages using mini-grids and SHS. According to the population demand, some habitats will be connected to a mini-grid, while others will receive SHS.

The results are provided in the form of graphs displaying the project performance over time (expenses, revenues, net cash flow...), along with KPI calculations, including internal rate of return (IRR) and the net present value (NPV). The projects are assessed for 25 years, with an analysis conducted every year. The mini-grid and SHS are assessed separately, but all the results are merged in the Simulation results sheet.

The tool was elaborated in a dynamic format, linking all inputs and outputs together, making it easy for the end-user to evaluate electrification projects according to different criteria including revenues, expenses, and the company's financial situation.

To use this tool, having some knowledge of finance and energy is recommended.

2 Obtaining the tool

The financial tool FATE will be freely accessible on the PeopleSuN website, allowing users to access the financial tool content (including the manual). It is available in a Nigeria-specific version, tailored to the local currency and adjusted to the country's economic conditions. This ensures that the tool aligns with the professional requirements and financial considerations of the Nigerian context.

FATE will also be available for use on the Energypedia website - *Nigeria off grid Solar Knowledge hub*.

Direct Access to the website : https://energypedia.info/wiki/Nigeria_Off-Grid_Solar_Knowledge_Hub

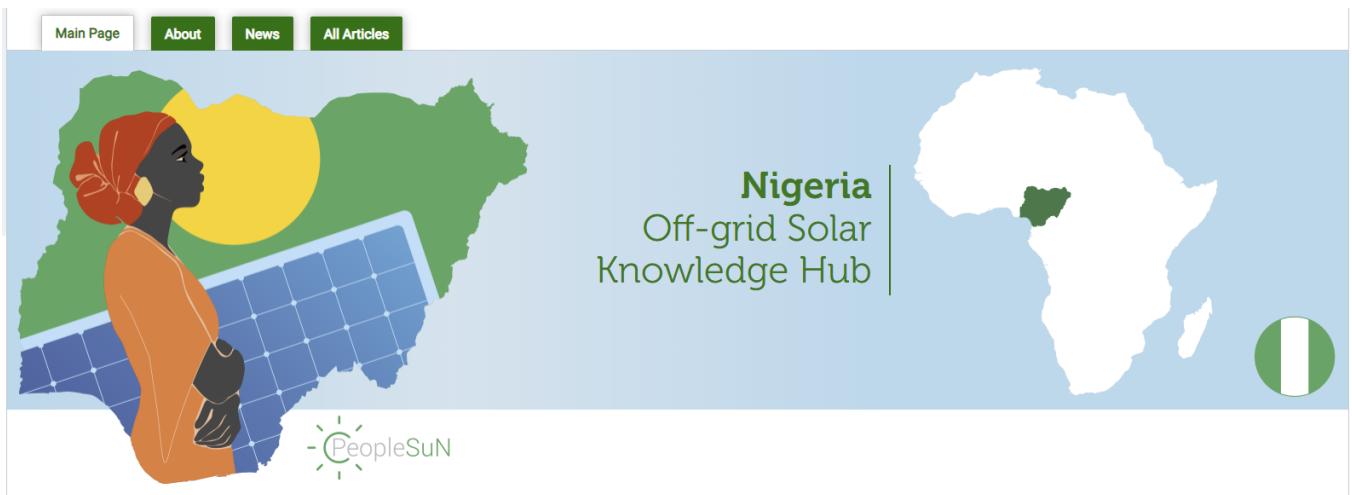


Figure 2: Energypedia interface

This tool was designed on Microsoft 365 MSO (Version 2305 Build 16.0.16501.20074) 64-bit Excel. It is fully compatible only with this version (2021) or later versions. If the user chooses to use it on a version declared incompatible, there is a risk of data loss and significant loss of functionality, making the tool unreliable.

3 Properly access the content of the tool

First and foremost, for the proper functioning of the FATE tool, there are some steps to follow. Indeed, depending on the device and the Excel usage habits of the users, they may encounter different warning messages.

3.1 Enable Content

The first error that appears is the content activation prompt. This can manifest in different ways, such as the two examples that follow: in a banner above the content or in the form of a pop-up window.

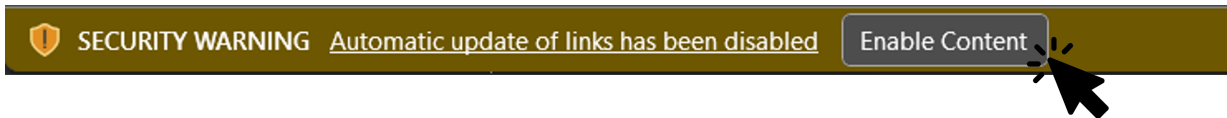


Figure 3: Enable content Alert

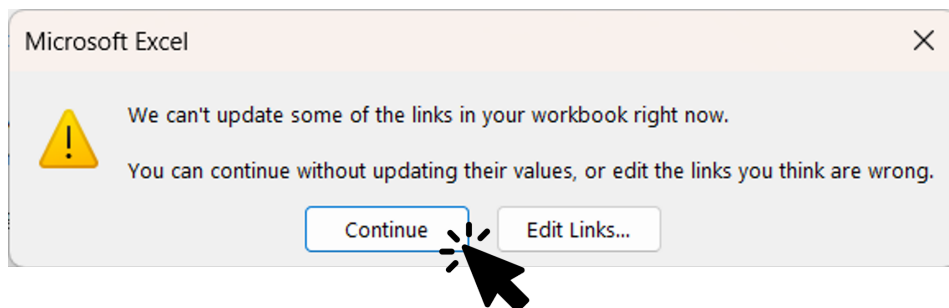


Figure 4: Enable content Pop Up Alert

In any case, users must choose to continue to use FATE properly.

3.2 Activate Macros

This tool uses macros. Macros are a specific feature of Excel that may not be enabled on the user's computer depending on whether the person is accustomed to using them but also according to the computer security.

These steps are not necessary to follow if no macro-related warning messages are displayed and everything is working normally in the tool.

There are two different possibilities: the macros are blocked for security reasons or they are not activated on Excel.

First, for the security issue, the user needs to disable content protection at the file level. They should navigate to the folder where the file is located. If the user just downloaded the content, it is likely located in the Downloads folder.

Next, right-click on the relevant file and access the properties.

A window will appear: simply uncheck the icon at the bottom right of this window, "Unblock," click on **Apply**, and then click **OK**.

After completing this operation, when you follow the same steps again, the previously unchecked option will no longer appear: the content has been successfully unblocked.

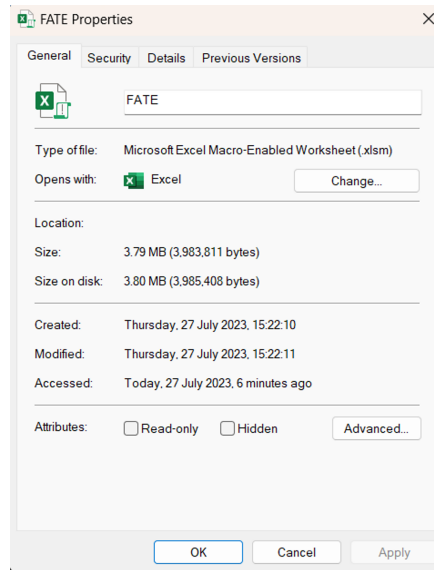


Figure 5: Excel file properties

The user may need to enable macros in Excel.

To do this, it's very simple: just go to **File > Options**.

When the user clicks on Options, a window will appear. Then, they need to click on **Trust Center**.

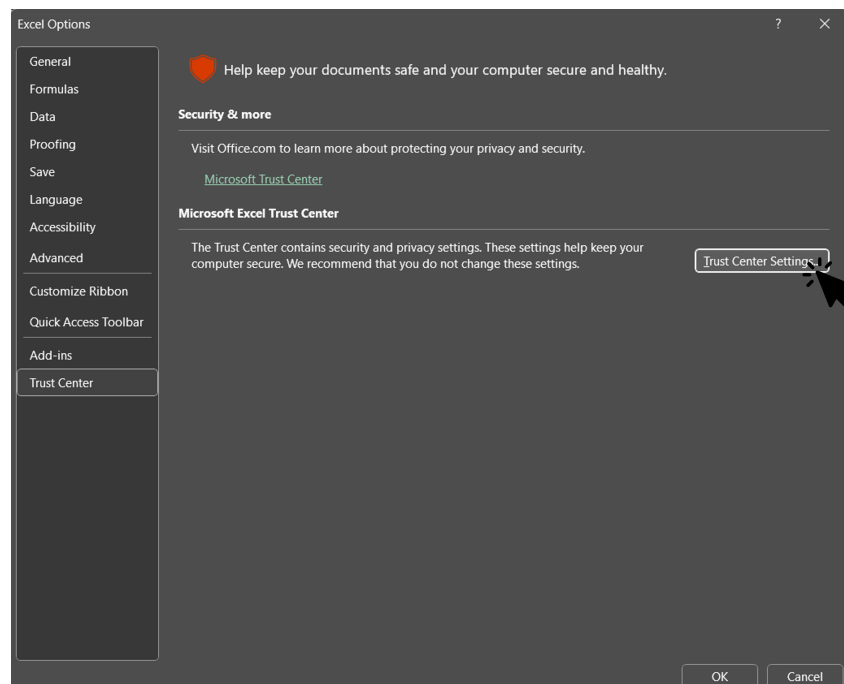


Figure 6: Activation of the macros on Excel : Part 1

When the Trust Center window appears, to access its settings, click on **Trust Center Settings**. Then, the specific window for Trust Center settings will appear. Click on **Macros Settings**. There, you will need to enable the activation of VBA macros to make the content work.

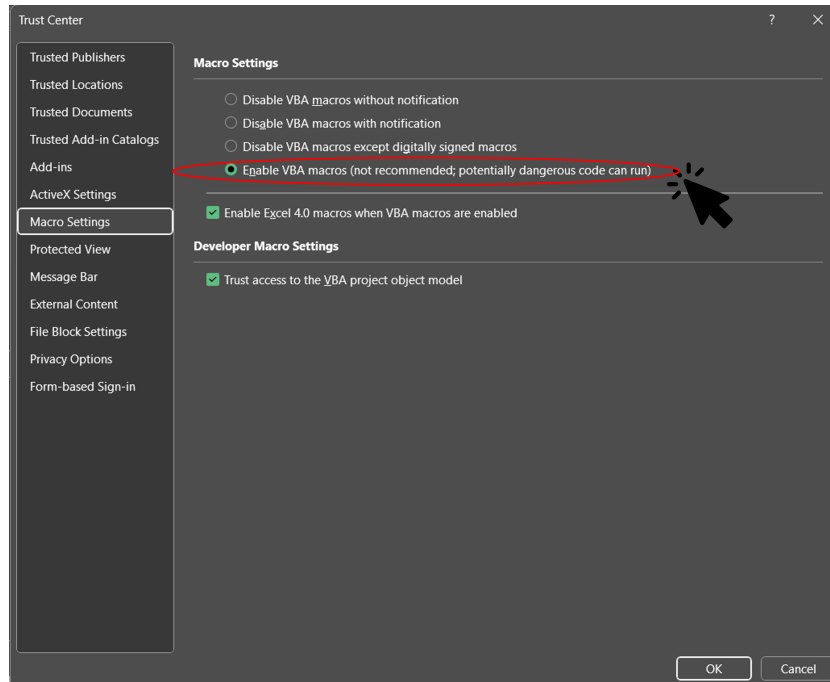


Figure 7: Activation of the macros on Excel: part 2

It is not necessary to check the last box; you can also work with the second-to-last one in the case of this tool, if it does not cause any issues during execution.

4 User interface

In this section, the user will find a detailed description of the various elements that make up the user interface of the tool. These include buttons, icons, and other interactive components that are essential for carrying out various tasks. Each element is accompanied by a detailed explanation of its functionality and how it can be used to achieve specific goals.

4.1 Tool structuring

This tool contains fifteen different sheets on which the user can browse. Each one of these sheets has its color and symbol.



1. Introduction

General instructions, Definition, and Abbreviations



2. Control Table

Table for data entry



3. Simulation Table

Centralised results for all the different scenarios



4. Indexation and Financing

Intermediate results



5. Minigrid

Intermediate results



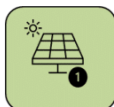
6. Depreciation

Intermediate results



7. SHS1 25 years

Intermediate results



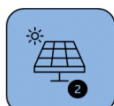
8. SHS1 5 years

Intermediate results



9. SHS2 25 years

Intermediate results



10. SHS2 5 years

Intermediate results



11. Summary of values

Referencing all the data used for the results table.



12. Table of contents **FACULTATIVE**

Summary of all sheets and their contents



13. Assumptions **FACULTATIVE**

List and explanation of the different assumptions used



14. Default Data **FACULTATIVE**

Demand data coming from a real village



15. References **FACULTATIVE**

Documents used to make the tool

The user might know that some of the sheets are facultative. When the user starts the tool, they are hidden. To access the content, the user has to check the associated box in the 'Introduction and General Instruction Sheet'.

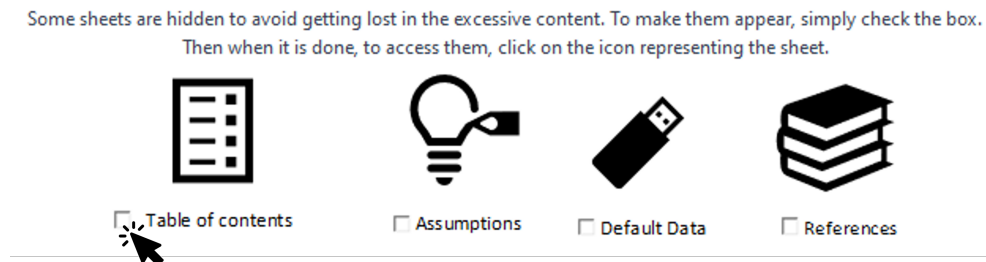


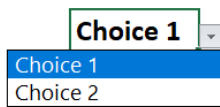
Figure 8: Activation of the hidden sheets

Within the content that the user can access, there are 11 different pages and 4 hidden pages that can be displayed as previously explained.

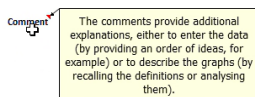
4.2 Functioning of the various tools



Plus icon This tool can be used to display rows or columns containing information for the user. Simply click on the plus icon with the mouse to access the information they contain. On the other hand, to make them disappear to clarify the sheet's appearance, simply press the minus icon which will have appeared.



Drop-down menu The drop-down menu allows the user to choose from a predefined list. To use this tool, they first need to click on the cell and then the drop-down is displayed in its entirety and it is possible to select the required cell.



Comments Comments are available throughout the tool. They specify certain points to help the user. As specified in the comment displayed, they provide a scale of values to enable reasonable data to be entered. Alternatively, in the case of graphs, they serve as a reminder of definitions and enable analysis. To access them, simply move your mouse over the red triangle in the top right-hand corner of the cell.



Check Box Checkbox options are available throughout the tool to make specific choices, such as whether to consider a certain system, display certain curves, or make other selections. The user must follow the instructions within the tool because, as with the checkboxes, the actions are specific, and each choice is detailed and explained.

4.3 Browsing in the tool



Help The user can consult the manual at any time. The manual is split into different parts: *How to Obtain the tool, User interface, User guide, Mains questions, Glossary, References*. The manual has been created to simplify the use of the tool, so it provides more detailed instructions compared to the prompts entered directly in the Excel tool.



General instructions icon The introduction contains some information on how to use the tool. To be more precise, it explains the functioning of the various tool and also the different types of cells. To be redirected there, the user can click on this icon at the top of every sheet on the right.



Definition icon When the user encounters a word or an abbreviation they don't know, they can peruse a dictionary to better understand. To be redirected there, the user can click on this icon at the right top of every sheet.



Back icon After consulting one of the sheets for example to get some information on a definition. The user can return to the page on which they were originally, clicking on this icon available at the top of every sheet on the left.



Control Table icon To make the tool operative, the user must complete the "Control Table" sheet entirely. Click on this icon to directly go to the Control Table sheet so they can continue to fill in the requested data.



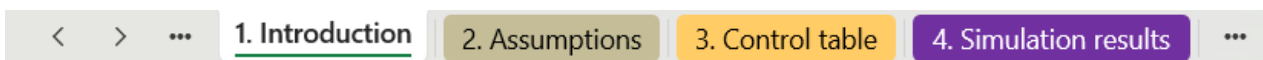
Simulation and Results icon The users must click on this icon to directly go to the Simulation and Results sheet. This sheet contains the main results of the tool but also links to the other sheet which contains partial results.



System results icon In the Control table sheet, next to the input data cells, some connected buttons permit to go directly on the associated result sheet. These buttons are also included in the Simulations and Results sheet to directly access them. The user can click on the button to go there.

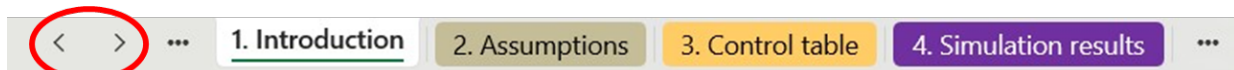
Nota bene: This icon is available for all spreadsheets in the section dedicated to them (Mini-grid, Mini-grid Depreciation, SHS1 25 years, SHS1/ SHS2 for 25 and 5 years)

It is possible to change of sheet by clicking on the desired sheet in the bottom bar.



In this area, there are tools for browsing:

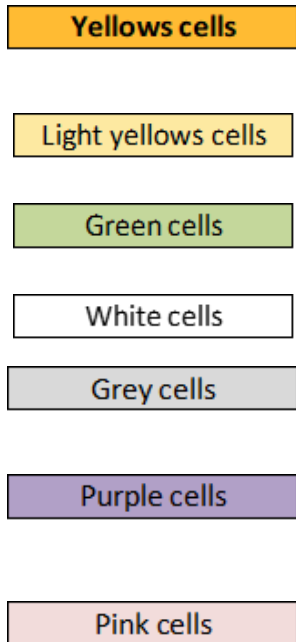
- on the left, the arrows allow the user to scroll through the tabs.



- on the right, clicking on the suspension points, it is possible to go directly to the next page.



4.4 Different types of cells



1. In these cells, users are asked to enter the data they have available. This is the most important data, so it must be chosen with care, and particular attention must also be paid to the units. Cells of this type are ONLY found in the "Control Table" sheet.
2. Data must also be entered in these cells. Particular attention must be paid to the units. Cells of this type are ONLY found in the "Control Table" sheet.
3. These cells contain important values, calculated from data the user has been asked to enter.
They shall not be modified.
4. These cells are the detail of calculations. They are containing formulas.
They shall not be modified.
5. These cells are showing intermediate results.
They shall not be modified.
6. These cells are showing the main results of the sheet. Cells of this type can be found in the spreadsheet for individual calculations but above all in the "Simulation results" sheet.
They shall not be modified.
7. These cells are showing the results input by the user in the "Control Table" as a reminder in other sheets.
They shall not be modified.

Main titles are shown in dark blue boxes, secondary titles in grey and tertiary titles in light blue.

5 User guide

This section is divided into different sub-sections to cover the main features of FATE.

It is recommended that the user takes into account the first section ("Introduction and General Instruction") before starting to use the tool. This makes users more efficient in their use of FATE, giving them the tools, assumptions, and explanations they need.

After that, it is advisable to fully complete the different inputs of the control table to display results adapted to the user's situation.

Then the user can browse the different spreadsheets to consult the expected results.

Each sheet begins with a general explanation of what it contains and what it will be used for. Each short introduction is very useful to the user, as it may contain information that will help them to understand the sheet better.

5.1 Introduction

The introduction serves as the homepage of the document, so when the user opens the document, they land on this page.

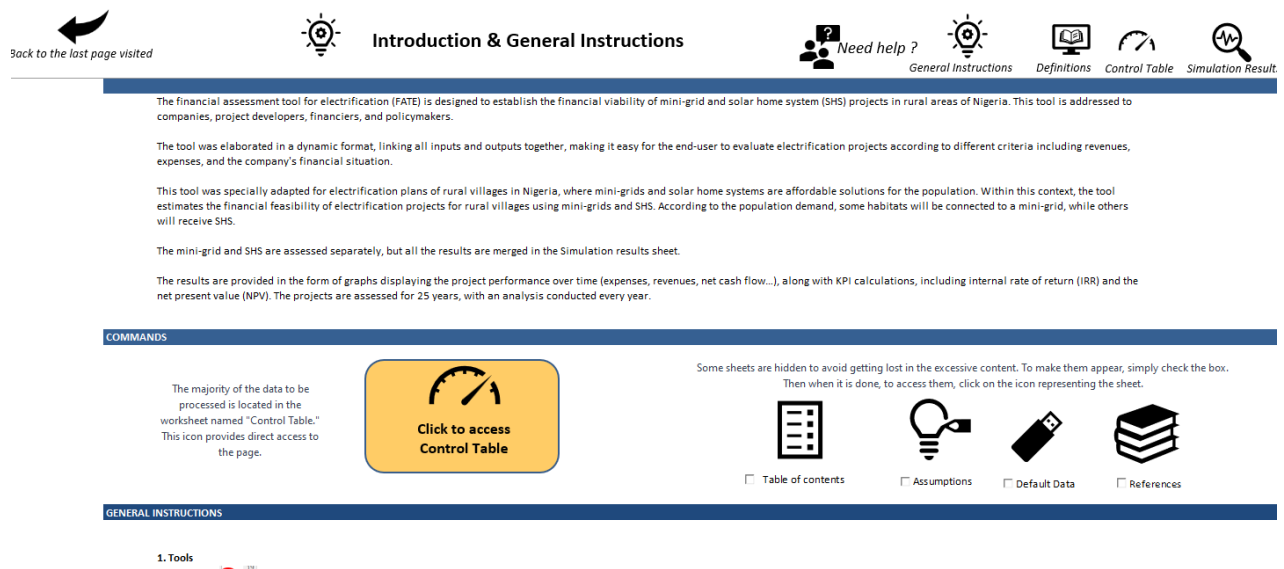


Figure 9: Introduction and General instructions interface

The introduction is structured into four parts: commands, contextualization and presentation of the tool, general instructions, and definitions and abbreviations.

The first part: 'Commands' allow the user to directly navigate to the page where the user enters the most information: the 'Control Table'.

The majority of the data to be processed is located in the worksheet named "Control Table." This icon provides direct access to the page.



Figure 10: Access to the Control Table

Furthermore, this section also allows control over access to the hidden sheets mentioned in the section 4.1.

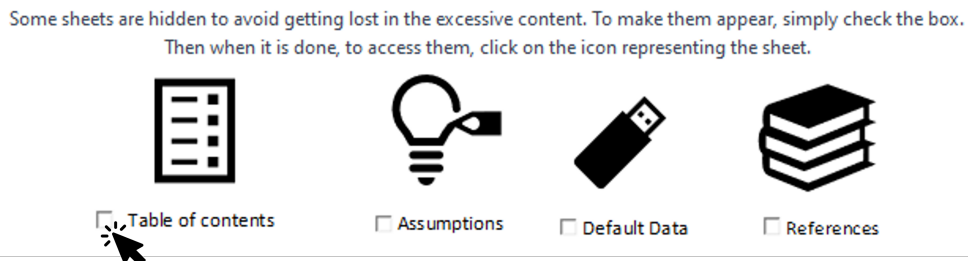


Figure 11: Activation of the hidden sheets

Simply select the checkboxes of the sheets you want to access, then click on the corresponding icon to navigate to them. The user has to note that if the link does not work to access the desired page after checking the checkbox, they simply have to click elsewhere on the sheet and then click on the desired icon.

The general instructions provide detailed information on all the available tools and usage tips. The explanation tools are interactive and can be used immediately. The color coding scheme used is introduced to the user to differentiate cells.

All this information is also referenced in the manual under the section "User Interface" and then under "Functioning of the Various Tools and Browsing in the Tool."

Then, the last part is divided into three sections: technical abbreviations, financial abbreviations, and definitions. All this information is referenced in the manual under the Nomenclature for the abbreviations and under the Glossary section for the definitions. Users can refer to these sections whenever they have doubts about specific terms. However, the definitions of the most important data for result analysis are reiterated when the results are discussed.

5.2 Control table

This sheet contains the commands for the entire Excel tool. By completing it, each user will be able to run a financial simulation for seven different scenarios. The different scenarios are :

1. *Mini-grid*
2. *SHS1*
3. *SHS2*
4. *Mini-grid + SHS1*

5. Mini-grid + SHS2

6. SHS1 + SHS2

7. **Total: Mini-grid + SHS1 + SHS2**

The screenshot shows the 'Control table' interface. At the top, there is a navigation bar with icons for 'Back to the last page visited', 'Control table', 'Need help?', 'General Instructions', 'Definitions', 'Control Table', and 'Simulation Results'. Below this, a warning message states: 'This sheet contains the commands for the entire Excel tool. By completing it, each user will be able to run a financial simulation for seven different scenarios (Mini-grid, SHS1, SHS2, SHS1 + SHS2, Mini-grid + SHS1, Mini grid + SHS2, Total -Mini-grid + SHS1 + SHS2). It is very important to complete this sheet with the utmost care to be able to produce a financial model that is adapted to each location. Users are reminded that this sheet is the only one on which data will be entered. Changes to other sheets will not be taken into account or will distort the results.' Below the warning, there are three main buttons: 'CLEAR ALL' (blue), 'INITIAL VALUES' (orange), and a purple button labeled 'Click to see the Simulations Results'. To the right of the 'INITIAL VALUES' button, there is a note: 'Simply follow the x steps below to complete all the data required to operate the financial tool. When you have finished filling in the ENTIRE Control Table sheet, you can access the results.' Below these buttons, there is a section titled 'COMPANY INFORMATION' with the instruction 'STEP 0. Fill in the company information'. This section contains four input fields: 'Company name', 'Project', 'Country', and 'Contact details'. Below the company information section, there is a section titled 'DEMAND'.

Figure 12: Control Table Interface

Moreover, it is very important to complete this sheet with the utmost care to be able to produce a financial model that is adapted to each case.

Users are reminded that no values should be entered outside this form. Changes to other sheets will not be taken into account or will distort the results.

The Control table sheet starts with a small introduction that explains the content and the purpose of the sheet.

Then, the user can find three buttons that have an interest to complete the rest of the sheet.

This block provides detailed descriptions for the three main buttons shown in the screenshot. The 'CLEAR ALL' button is described as deleting all user-entered or default data. The 'INITIAL VALUES' button is described as returning all boxes to their default values. The 'Simulation and Results Button' is described as taking the user directly to the results sheet.

This sheet details the various steps (13) required to complete the tool. Every step explains what the user

needs to accomplish, detailed to make it as easy to use as possible. It also specifies the cells to be filled in.

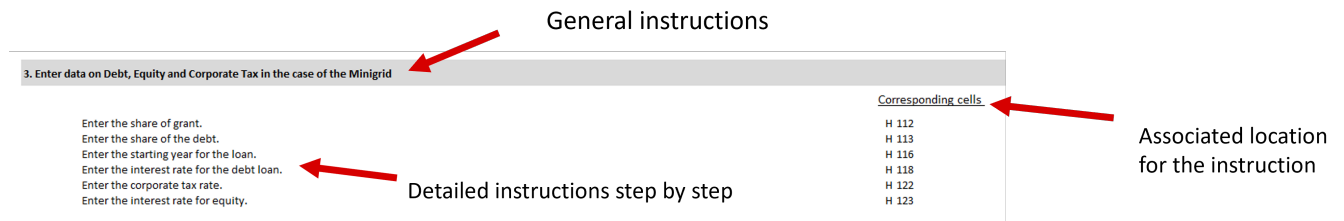


Figure 13: Instruction Example

5.2.1 STEP 0: Company Information

The previous step is filling in some information about the company. To enter the data the user must single or double-click on the expected cell and next type in what is requested.

COMPANY INFORMATION

STEP 0. Fill in the company information

Company name	
Project	
Country	
Contact details	

Figure 14: Company information

To exit the selected cell after completing it, simply click elsewhere on the sheet or press the Enter key.

5.2.2 STEP 1: Selection of default or manual approach for the demand data.

After completing the information regarding the company and the overall project context, the user needs to fill out the request from the village in question.

The user must choose between the two different approaches according to the data: Manual or Default.

DEMAND

STEP 1. Select either the default or the manual approach for the demand data.

Select the approach for the user demand data
Manual

Figure 15: Step 1 : General Instructions

As it was mentioned before, to get more information about this step, the user needs to click on the plus icon on the left.

1 In this section, you get to choose the demand data: the daily kWh consumption and the number of users.
Default option:
To showcase results from a pre-existing data set, simply choose "Default" from the drop-down menu. The default data is sourced from a genuine Nigerian village and is derived from the PeopleSUN project's WP3&WP4. It's advisable to utilize this approach initially, before making any alterations to the sheet. The initial cell values pertain exclusively to the selected village.
Manual option:
To customize the values, select the "Manual" option and fill in the yellow input cells. The data entered in those cells is for year 0 of the project and will evolve based on the indexation rate you choose in the Indexation & Financing section. Additionally, you can use the "full" manual mode to select demand data. For this, you will find drop-down lists in the mini-grid, SHS1, and SHS2 sections. If you opt for this option, ensure to fill in the demand cells (kWh consumption and the number of users) every year for the mini-grid and every five years for SHS.
Please be aware that this tool doesn't size the mini-grid according to the manual data you can choose here. You have to change the size of the mini-grid by modifying the input cells in the CAPEX part of the mini-grid.

2 Corresponding cells
I 54

3 Select the approach for the user demand data | Manual

Figure 16: Step 1 - Detailed Step

1 Detailed step: To guide the user step by step, each part has been detailed into sub-steps. These sub-steps provide context, sometimes provide definitions, but most importantly, provide instructions for each sub-step.

Corresponding cells : Opposite each sub-step, you can find the corresponding cells where you need to complete the instruction. All the cells mentioned here must be completed to initiate the calculations.

2 The two possible options are detailed below:

Default option	Manual option
To display results from a default data set, the user can select " <u>Default</u> " in the drop-down list below. In this case, the data come from a real Nigerian village due to PeopleSUN projects in WP3 and WP4. The initial values entered in the cells relate to this specific village.	If the user wishes to choose the values, they can select " <u>Manual</u> " and fill in the yellow input cells. The data entered in these cells is for year 0 of the project and evolves with the chosen indexation rate. It is also possible to use the "full" manual mode to choose the demand data. Some drop-down lists are available in the section dealing with SHS - <i>Step 8 and 13</i> . If the user chooses the "full" manual option, they have to fill in the number of users' cells every 5 years for SHS.

The user needs to know that this tool doesn't size the mini-grid according to the manual data. The size of the mini-grid must be changed by modifying the CapEx input cells for the mini-grid.

3

Objective Cell Finally, we have the referenced cell that has been mentioned since the beginning. In this case, it is a dropdown list, so you need to click on it to choose between manual input and default values.

5.2.3 STEP 1 BIS - Facultative - Further Information in manual approach, The demand data for the beginning of the project must be entered.

If the user has chosen Manual mode, they must fill in all the cells corresponding to the demand.

Demand data entry		Demand data entry		
For SHS 1 & 2 enter in the following table		For Mini Grid enter in the following table		
Type of Technology	Number of Users	Type of Consumer Sector	Demand in kWh/day	Number of Users
SHS 1	200	Residential	62	24
SHS 2	150	Community	105	18
		Commercial Small Scale	21	7
		Commercial large Scale & Anchor Load	68	17

Figure 17: Step 1 Bis - Demand Data

1. The user needs to enter the number of users for SHS1 and SHS2.
2. For the mini-grid, the user needs to enter the electricity demand in *kWh/year* and the number of users for each of the 4 categories: Residential, Community, Commercial Small Scale, and Commercial Large Scale and Anchor Load.

5.2.4 Exclusion of a system

From this step onwards, the entered data pertains to the Mini-grid, SHS1, and SHS2 systems.

It is possible to exclude certain systems if the user wishes to focus on a specific approach to the tool. For example, if the user does not want to see any solutions related to the Mini-grid, they simply need to check the corresponding box.

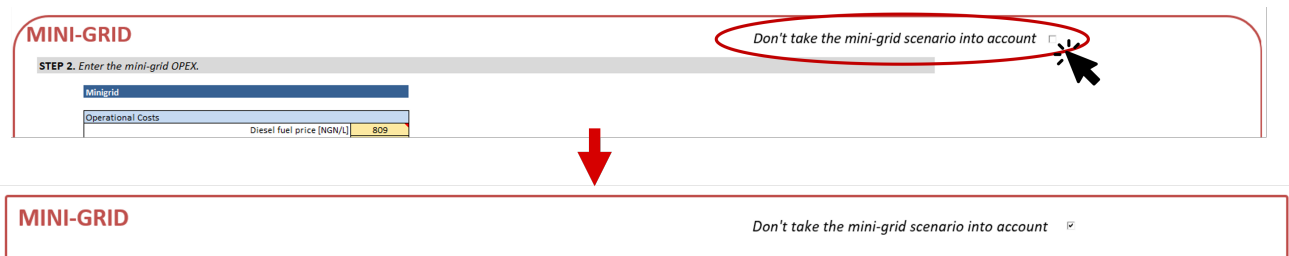


Figure 18: Exclusion of the Mini-grid system

In this way, the values will not be sent to the calculation sheets.

WARNING: It is not advisable to exclude all three systems at once as there are no other electrification modes considered.

5.2.5 STEP 2: Mini-grid OpEx Values

The section on completing the information on the use of mini-grids starts here.

As a reminder, OpEx refers to the ongoing costs incurred by a business to maintain its day-to-day operations and support revenue-generating activities.

Minigrid	
Operational Costs	
Diesel fuel price [NGN/L]	809
Diesel fuel consumption [L/year]	2 500
Service & Maintenance [NGN/year]	150 000
Local operational management [NGN/year]	200 000
Insurance [NGN/year]	350 000
Miscellaneous [NGN/year]	700 000

Figure 19: Step 2 - OpEx Data

In this part, the user just has to complete the operational costs mentioned here. These are set for the beginning of the project.

Here, in the different steps, as numerical values need to be entered, ranges of values are provided to allow the user to validate the entered data. The value ranges are available in the notes section. To access these notes, simply hover the mouse over the red corners of the cells.

Minigrid	
Operational Costs	
Diesel fuel price [NGN/L]	809
Diesel fuel consumption [L/year]	2 500
Service & Maintenance [NGN/year]	150 000
Local operational management [NGN/year]	200 000
Insurance [NGN/year]	350 000
Miscellaneous [NGN/year]	700 000

The value was 809 NGM/L in January 2023

Figure 20: Step 2 - Comments

5.2.6 STEP 3: CapEx for the Mini-grid

As a reminder, CapEx refers to the funds used by a company to acquire, upgrade, or maintain physical assets such as property, equipment, or infrastructure, to generate long-term value or future benefits.

There are 3 types of capital investments for mini-grid: power generation, power distribution, and customer connection. The price and also the quantity is asked for some types of equipment. The user must be sure the quantities are consistent from one asset to another.

Minigrid	
Power Generation	
Solar PV [kWp]	60
Solar PV (incl. mounting system) [NGN/kWp]	300 000
Battery [kWh]	180
Battery (incl. rack) [NGN/kWh]	85 250
Inverters (battery and PV) or charge controller [kVA]	27
Inverters (battery and PV) or charge controller [NGN/kVA]	160 000
Diesel genset incl. tank [kW]	60
Diesel genset incl tank [NGN/kW]	120 000
Distribution box, lightning protection, etc.	1
Distribution box, lightning protect, etc.[NGN]	4 325 000
Installation costs [NGN]	2 475 000
Shipping costs [NGN]	7 000 000
Power Distribution	
Low Voltage Distribution grid [km]	3.8
LV distribution grid [NGN/km]	1 241 000
Medium Voltage distribution grid MV [km]	2.7
MV distribution grid [NGN/km]	4 517 000
Power house [NGN]	1 734 000
Fencing [NGN]	500 000
Foundations and Poles [NGN]	1 335 960
Shipping [NGN]	890 000
Installation [NGN]	3 152 200
Customer connection	
Grid connection cost [NGN/user]	40 000

Figure 21: Step 3 - CapEx Data

- It is necessary to enter the costs and quantities for power generation assets.
 - For the cost of the solar panels, in Nigeria the range is 250,000 to 350,000 per kWp
 - For the batteries, in Nigeria they cost 80,000 to 160,000 NGN per kWh
 - For the inverters (battery and PV) or charge controller, in Nigeria it should cost 100,000 to 200,000 NGN per kVA
 - For the diesel genset, it should cost 100,000 to 150,000 NGN/kW
- The user must enter the costs and quantities for power distribution assets.
 - For the Low voltage distribution grid, it should cost 1,000,000 to 1,500,000 NGN/km
 - For the medium voltage distribution grid, it should cost 4,000,000 to 5,000,000 NGN/km
 - For the fencing, it should cost 7,000 to 9,000 NGN/m
 - For the foundation and poles, it should cost 300,000 to 400,000 NGN per pole
- The user must enter the shipping and installation costs.
- Enter the cost for connecting a new user to the mini-grid.
It cost 40,000 to 50,000 NGN per new connection

5.2.7 STEP 4: Revenue for the Mini-grid

Revenue refers to the total amount of money earned or generated by a company through its primary business activities, typically from the sale of goods, provision of services, or other income-generating sources.

This section synthesizes what the users have to pay to the owner of the mini-grid. The owner can make sure his project is profitable by choosing the correct prices.

Consumer Sector Wise Tariff [NGN/kWh]		
Residential		64
Community		64
Commercial Small Scale		70
Commercial Large Scale & Anchor Load		80

Consumer Sector Wise fixed costs [NGN/year/user]		
Residential		120
Community		110
Commercial Small Scale		130
Commercial Large Scale & Anchor Load		150

Consumer Sector Wise connection fee [NGN/user]		
Residential		5 000
Community		4 000
Commercial Small Scale		6 000
Commercial Large Scale & Anchor Load		8 000

Consumer Sector Wise metering costs [NGN/year/user]		
Residential		160
Community		150
Commercial Small Scale		170
Commercial Large Scale & Anchor Load		180

Figure 22: Step 4 - Revenue Data

1. The user must enter the mini-grid electricity tariff for the 4 categories of users.

Grid tariffs by category are detailed below:

- Residential: 27 NGN/kWh
- Community: 27 NGN/kWh
- Commercial Small Scale: 29 NGN/kWh
- Commercial Large Scale & Anchor Load: 36 NGN/kWh

2. The user must enter the mini-grid connection fee for new customers.

3. The user must enter the fixed electricity charges for the 4 categories of users.

The user may know that fixed charges for the grid users in Nigeria were 700 to 800 NGN/month in 2015

4. The user must enter the metering costs for the 4 categories of users.

This is the point at which the first calculation results will be available. It is possible to access results about Mini-grid by clicking on a button that was introduced earlier.

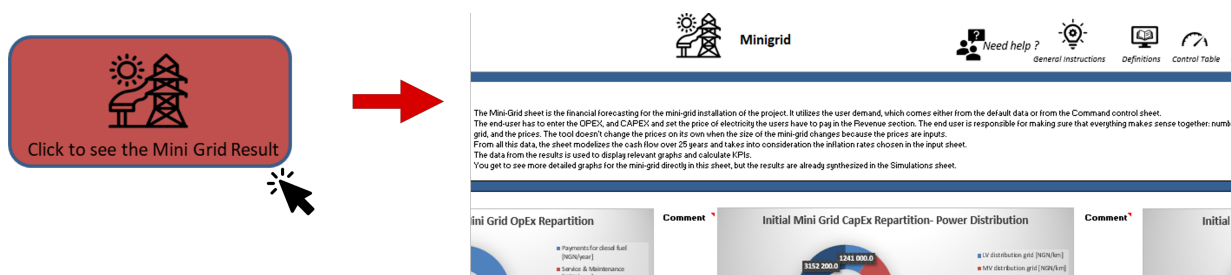


Figure 23: Direct access to the Mini-grid sheet

Once you have completed all the data for a given section, you will be able to access the results directly using the associated button. Buttons are available for each result sheet.

5.2.8 STEP 5: Mini-grid Depreciation

Depreciation refers to the decrease in the value of an asset over time, recorded as an expense on a company's financial statements to reflect the reduction in the value of tangible or intangible assets. Here, the depreciation of assets is calculated for the mini-grid, but not for SHS because once installed it doesn't belong to the company anymore. The company leading the electrification project can only sell back assets from the mini-grid. The end user chooses the salvage value which is the remaining value of an asset after its active life. Also,

this is the sheet where the user chooses the life span of the assets and if reinvestments are needed.

With this input data, the sheet determines the remaining value of assets which is part of the KPI calculation.

Depreciation sheet		
Expected salvage value [%]	5.0%	
Depreciation of generation assets		
	Reinvestment Required [Yes/No]	Depreciation duration [year]
Solar PV (incl. mounting system) [NGN]	Yes	25
Battery (incl. rack) [NGN]	Yes	6
Inverters (battery and PV) or charge controller [NGN]	Yes	10
Diesel genset incl tank xx kVA [NGN]	Yes	10
Distribution box, lightning protect, etc.[NGN]	Yes	8
Installation costs [NGN]	No	10
Shipping costs [NGN]	No	10
Depreciation of distribution and fixed assets		
	Reinvestment Required [Yes/No]	Depreciation duration [year]
LV distribution grid [NGN]	Yes	25
MV distribution grid [NGN]	Yes	25
Power house [NGN]	Yes	25
Fencing [NGN]	Yes	25
Foundations [NGN]	Yes	25
Shipping [NGN]	No	25
Installation [NGN]	No	25

Figure 24: Step 5 - Depreciation Information for Mini-grid

1. The user has to fill in the expected salvage value, which is the remaining value of a product after its active life.

To be realistic, it should not exceed 10%

2. In the power generation section, the user needs to choose if the corresponding asset requires reinvestments during the project. For that, they need to tick "Yes" or "No" in the drop-down lists.

3. In the power generation section, the user needs to fill in the expected life spans of assets.

- For the solar panel, which includes a mounting system, the depreciation might be at least 25 years.
- For the battery, which includes a rack, the depreciation duration can vary between 5 and 10 years.
- For the inverters (battery and PV) or the charge controller depreciation duration, is considered between 10 and 12 years.
- For the diesel genset, which incl tank depreciation duration, depending on the frequency of the use. A duration of 10 years is reasonable.
- For the distribution box and lightning protection, the depreciation duration is estimated at 10 years.

4. The user has to repeat the last two steps for the power distribution section.

All of the distribution assets should last for the whole 25 years of the project.

All the required data for mini-grid financial forecasting is now filled, and it is possible to analyse the results displayed on the Mini-grid and the Depreciation sheet.

5.2.9 STEP 6: Number of SHS1 users and their type of loan over 25 years

Here begins the section concerning Solar Home Systems (SHS), which come in two types: the first one has a lower installed capacity than the second one. Similarly to the Mini-grid, it is possible to exclude the SHS by checking the corresponding checkbox.

Firstly, the user will need to enter the data concerning SHS1.

'SOLAR HOME SYSTEM 1

STEP 6. Enter the number of SHS1 users and their type of loan.

Consumer Sector Wise number of users	
Do you want to enter the number of new user manually ?	No
If you have ticked Yes, please click on the + on the left to fill in the values you require.	
Year 6	88
Year 11	53
Year 16	26
Year 21	7
PAYG (based on 24 months)	
Percentage of people missing the PAYG payment each month	10%

Figure 25: Step 6 - SHS1 Users

- The user must decide whether they want to manually enter the number of individuals to be added to the SHS users. To do so, they must choose from the associated dropdown list.
 - If the user chooses to not put manually the new users of SHS1, the number will change automatically based on the value entered for the expected increase in the Indexation section.
 - If the user chooses to enter manually the data, they need to do it for each 5-year cycle.
- It has been decided that all the users have to pay with the PAYG (Pay As You Go), based on a 24-month installment model that is paid back each month. The user needs to enter the expected percentage of installments missing each month.
This percentage should not exceed 50%, otherwise some calculations could fail. The assumption made is that there are not the same people who miss the payment each month, so they all pay back the loan fully at the end

5.2.10 STEP 7: OpEx for SHS1, 25 years

As a reminder, OpEx refers to the ongoing costs incurred by a business to maintain its day-to-day operations and support revenue-generating activities.

In the case of SHS, there are different types of OpEx (Operational Expenditures) as two different services are provided. On one hand, there are new SHS users who will own the system after five years. On the other hand, there are existing users who will only change the batteries every five years, as recommended.

Operational Costs	
New SHS Users	
PAYG costs	
PAYG standard platform fee [NGN/month]	37 000
PAYG activation fee per user [NGN/month/user]	130
SMS per user [NGN/month/user]	150
Other operational costs	
Other costs (warranty + repairs) [NGN/month]	5 000
Battery Replacement	
PAYG costs	
PAYG standard platform fee [NGN/month]	20 000
PAYG activation fee per user [NGN/month/user]	80
SMS per user [NGN/month/user]	100
Other operational costs	
Other costs (warranty + repairs) [NGN/month]	2 500

Figure 26: Step 7 - OpEx for SHS1, 25 years

- For the new users of SHS :

- The user needs to enter the standard platform fee. This is a fixed monthly fee paid to the PAYG platform no matter how many users there are (as long as there are PAYG installments left).
The estimated price is 35 000 to 40 000 NGN/ month
- The user needs to enter the activation fee per user. This is a fee to pay to the PAYG provider every month which is proportional to the number of users that paid a PAYG installment that month.
For this size of SHS, in the case of PAYG, the fee is approximately 130 NGN/ month/user
- The fee for the text messages sent per user is also required.
It is usually estimated around 150 NGN/month/user
- The other operational costs are also asked. These can come from warranties and repairs of the SHS. This is the only source of OPEX that is not about PAYG.

2. **For the battery replacement**, repeat the same steps as for the new users of SHS.

5.2.11 STEP 8 : CapEx for SHS1, 25 years

As a reminder, CapEx refers to the funds used by a company to acquire, upgrade, or maintain physical assets such as property, equipment, or infrastructure, to generate long-term value or future benefits.

Capital Investments	
Fosera SPARK (incl. mounting system) [NGN/unit]	40 000
PAYG Onboarding fee [NGN]	220 000
Shipping costs [NGN]	10%
Other costs [NGN]	50 000
Battery	10 000

Figure 27: Step 8- CapEx for SHS1

1. The model of the solar home system chosen here is SPARK from Fosera, the technical data sheet is available in the appendix.
The user is asked to enter the price. The price for this size of SHS is between 28,000 and 40,000NGN per unit
2. The user has to enter the PAYG onboarding price.
The PaygOps Onboarding fees are around 220,000 NGN
3. The user is asked to enter the installation cost (as a percentage of the SHS cost) and also the other cost if there is any.
4. The battery cost is requested.
As Fosera does not sell batteries on their own, we take the equivalent of a battery 50 units, 12.8V, 3.8Ah, 48.6 Wh. The price range is between 5,000 and 12, 000 NGN

5.2.12 STEP 9: Revenue inputs for SHS1

Revenue refers to the total amount of money earned or generated by a company through its primary business activities, typically from the sale of goods, provision of services, or other income-generating sources.

The revenue comes from one type of loan: PAYG (Pay As You Go).

Revenue	
Total project cost paid at the down payment (PAYG) [%]	10%
Interest rate (PAYG for the 5 years) [%]	60.0%

Figure 28: Step 9 - Revenue inputs for SHS1

1. The user has to enter the percentage of the project cost that is paid through the initial down payment for an SHS with PAYG.
2. They need to put the interest rate (which represents the profit) for a PAYG loan for the whole SHS life span.

All the required data for SHS1 financial forecasting is now filled. You can analyse the results displayed at the bottom of the SHS1 25 years sheet using the button on the right.

5.2.13 STEP 10 : SHS1 Information over 5 years of use

This sheet gives a monthly analysis of SHS1 cash flows. As a reminder, cash flows refer to the movement of money into and out of a business or investment over a specific period, including both inflows (receipts) and outflows (payments). As it focuses only on the first SHS cycle, there is no manual option for entering the number of users.

SHS1 5 YEARS	
Consumer Sector Wise number of users	
PAYG (based on 24 months)	
Percentage of people missing PAYG payment each month	10%
Operational Costs	
New SHS Users	
PAYG costs	
PAYG standard platform fee [NGN/month]	37 000
PAYG activation fee per user [NGN/month/user]	130
SMS per user [NGN/month/user]	150
Other operational costs	
Other costs (warranty + repairs) [NGN/month]	5 000
Capital Investments	
Fosera SPARK (incl. mounting system) [NGN/unit]	60 000
PAYG Onboarding fee [NGN]	220 000
Shipping costs [NGN]	10%
Other costs [NGN]	50 000
Revenue	
Total project cost paid at the down payment (PAYG) [%]	10%
Interest rate (PAYG)	60.0%

Figure 29: Step 10 - SHS1 over 5 years of use

Apart from that, this is the same input cells so you can follow steps 6 to 9 again.

1. Fill in the number of SHS1 users and their type of loan.
2. Fill in the Operational Cost
3. Fill in the Capital Investments
4. Fill in the different revenue

The results give a more detailed approach.

But as this sheet is not linked to the simulation results sheet, the users are not obliged to enter the data here if they don't need this detailed monthly analysis.

5.2.14 STEP 11 : SHS2 Information

The filling of SHS2 25 years and SHS2 5 years sections are the same as for SHS1.

SOLAR HOME SYSTEM 2

STEP 11. Fill in the SHS2 information (5 and 25 years)

Figure 30: Step 11

The only differences are:

- the SHS model, which is bigger (Fosera IGNITE). The technical data sheet is available in the appendix.
- The PAYG activation fee is more expensive than for SHS1. The tariff changes because the SHS model is more expensive so there is more money going through the PAYG platform.

Apart from that, the user can use the same instructions given for SHS1 to fill the SHS2 sheets, basically repeating steps 6 to 10.

SHS2 - 25 YEARS	
Consumer Sector Wise number of users	
Do you want to enter the number of new users manually?	No
<i>If you have ticked yes, please click on the + on the left to fill in</i>	
PAYG (based on 24 months)	
Percentage of people missing the PAYG payment each	10%
Operational Costs	
New SHS Users	
PAYG costs	
PAYG standard platform fee [NGN/month]	37 000
PAYG activation fee per user [NGN/month/user]	225
SMS per user [NGN/month/user]	150
Other operational costs	
Other costs (warranty + repairs) [NGN/month]	5 000
Battery Replacement	
PAYG costs	
PAYG standard platform fee [NGN/month]	20 000
PAYG activation fee per user [NGN/month/user]	80
SMS per user [NGN/month/user]	100
Other operational costs	
Other costs (warranty + repairs) [NGN/month]	5 000
Capital Investments	
Fosera IGNITE (incl. mounting system) [NGN/unit]	200 000
PAYG Onboarding fee [NGN]	220 000
Shipping costs [NGN]	10%
Other costs [NGN]	50 000
Battery	20 000
Revenue	
Total project cost paid at the down payment (PAYG) [%]	10%
Interest rate (PAYG for the 5 years) [%]	60.0%

Figure 31: Step 11 Part 1 - SHS2 over 25 years of use

SHS2 - 5 YEARS	
PAYG (based on 24 months)	
Percentage of people missing the PAYG payment each month	10%
Operational Costs	
New SHS Users	
PAYG costs	
PAYG standard platform fee [NGN/month]	37 000
PAYG activation fee per user [NGN/month/user]	225
SMS per user [NGN/month/user]	150
Other operational costs	
Other costs (warranty + repairs) [NGN/month]	5 000
Capital Investments	
Fosera IGNITE (incl. mounting system) [NGN/unit]	250 000
PAYG Onboarding fee [NGN]	220 000
Shipping costs [NGN]	10%
Other costs [NGN]	50 000
Revenue	
Total project cost paid at the down payment (PAYG) [%]	10%
Interest rate (PAYG)	60.0%

Figure 32: Step 11 Part 2- SHS2 over 5 years of use

1. The user has to enter the data for SHS2 - 25 years.
2. The user has to enter the data for SHS2 - 5 years

5.2.15 STEP 12: Choice of the revenue and cost indexation.

It is important to note that the 'Indexation & Financing' section depends on the three previous sections (Mini-grid, SHS1, SHS2) as the data to be filled in here is system-specific.

In this step, it is possible to look at the aspects of indexation and financing of the project. This is where the inflation rate is considered, as well as the expectations regarding the evolution (increase or decrease) in user demand, and the rise of mini-grid electricity tariff.

This step is very important, it has a big influence on the financial forecasting in this tool.

All the values entered here stay the same for the whole project, so the user might consider using the expected average values for the whole 25 years except battery data, which is considered after 5 years of use.

INDEXATION & FINANCING

STEP 12. Choose the revenue and cost indexation.

Indexation & Financing			
General			
Project Information		Cost and Revenue Indexation	
Starting Year of the Project (Year 0)	2023	General Cost Indexation [%]	10.00%
Mini-grid			
Cost and Revenue Indexation			
			Indexation[%]
Diesel fuel Price Indexation [NGN/L]	3.80%	Metering charges for residential users [NGN/month/user]	6.50%
Fixed charges for residential users [NGN/month/user]	6.50%	Metering charges for community users [NGN/month/user]	6.50%
Fixed charges for community users [NGN/month/user]	6.50%	Metering charges for commercial small scale users	6.50%
Fixed charges for commercial small scale users	6.50%	Metering charges for commercial large scale & anchor	6.50%
Fixed charges for commercial large scale & anchor load users	6.50%	Expected increase in the mini-grid electricity tariff per	7.00%
		Expected increase in mini-grid demand per year	9.00%
		Expected increase in number of mini-grid users per year	2.00%
SHS			
Cost and Revenue Indexation		Batteries	
Expected increase in number of SHS users per year	2.00%	Percentage of people who want their batteries changed	80.00%
		Percentage of people who want their batteries changed	80.00%

Figure 33: Step 12 - Indexation and Financing- Revenue and Cost Indexation

1. General Information

- The user must enter the starting year of the project, which corresponds with Year 0 all along the tool. This is the year when the contract is established. The mini-grid and SHS will be ready for use in Year 1.
- The user must enter the general cost indexation. This rate will be applied by default unless a different indexation rate is applicable.
In Nigeria, the inflation rate has been between 6% and 17% for the past 20 years. On average, in countries from the west of Europe or North America, the overall inflation rate is 3.5%

2. Mini-grid

- The user must enter the diesel fuel cost indexation rate.
On average diesel fuel price inflation worldwide 3.8%
- The user must enter the fixed electricity charges indexation rate for the 4 categories of mini-grid users.
No data to give a range, but should probably be less than the electricity tariff increase
- The user must enter the metering electricity charges indexation rate for the 4 categories of mini-grid users.
- The user must enter your expected increase in your mini-grid electricity tariff.
On average, the electricity tariff increase is 7% over the past 15 years in Nigeria
- The user must enter the expected increase rate in mini demand.
Estimates predict between 6% to 12% increase per year
- The user must enter the expected increase of mini-grid users.
The expected increase in population per year in Nigeria is 2% for the next 25 years

3. SHS

- (a) The user must enter the expected increase of new users for the SHS 1 and 2.
The expected increase in population per year in Nigeria is 2% for the next 25 years
- (b) For the SHS, after 5 years, the system belongs completely to the user. The user has to simply keep the system without any add-ons or continue it by changing the batteries. It is recommended to change batteries every 5 years to ensure long service life. Enter the percentage of people who want their batteries changed and maintained after the first 5 years of use for SHS1 and SHS2.

5.2.16 STEP 13: Data on Debt, Equity, and Corporate Tax

The user must fill in more information about Indexation and Financing in this section.

STEP 13. Enter data on Debt, Equity, and Corporate Tax in each scenario

Indexation and Financing			
General			
Financing			
Share of grant for assets		5.00%	
Share of the debt		75.00%	
Mini-grid			
Debt		Input for Cashflow and KPI calculation	
Starting Year of the Loan	2025	Company income tax rate	24.0%
Load Tenor (years)	25	Interest Rate Equity	20.0%
Interest rate for Loan	11.00%		
Debt Grace Period (years)	3		
SHS1			
Debt		Input for Cashflow and KPI calculation	
Starting Year of the Loan	2025	Company income tax rate	24.0%
Load Tenor (years)	25	Interest Rate Equity	20.0%
Interest rate for Loan	11.00%		
Debt Grace Period (years)	3		
SHS2			
Debt		Input for Cashflow and KPI calculation	
Starting Year of the Loan	2025	Company income tax rate	24.0%
Load Tenor (years)	25	Interest Rate Equity	20.0%
Interest rate for Loan	11.00%		
Debt Grace Period (years)	3		

Figure 34: Step 13 - Indexation and Financing- Debt, Equity, and Corporate Tax

1. General Information

- (a) The user must enter the share of the grant.
- (b) The user must enter the share of the debt.

2. Mini-grid

- (a) The user must enter the starting year for the loan.
- (b) The user must enter the load tenor.
- (c) The user must enter the interest rate for the debt loan.
The average interest rate is 11.5% in Nigeria. (6% to 17% between 2007 and 2023)
- (d) The user must enter the debt grace period
- (e) The user must enter the corporate tax rate.

(f) The user must enter the interest rate for equity.

In Nigeria, between 2000 and 2021 the average return rate on Equity is 20%. The latest value was 12.8% in 2021.

3. Solar Home System 1 & 2

(a) Repeat the four previous steps for SHS 1 & 2

This is where the 'Control Table' worksheet ends. It must be fully completed (except for sections related to an excluded system) to generate a coherent output.

5.3 Simulation results

The results sheet contains the data that has been selected as the most relevant financial indicators for assessing achieved performance.

This sheet is separated into four different steps :

1. General Commands
2. Projects Performances, KPIs
3. Systems Results
4. Graphs

To better understand this sheet, which is one of the most critical, the user can count on five different steps. (*Scenario choice, KPIs, System Results, Graphs, Download a report*)

Simulation results

This is where all the main results are displayed. The end user can analyze the different graphs (Number of users, OPEX, CAPEX, Revenue, Net cash flow, and Cumulated cash flow). He can use the filters to display only what he wants on the graphs (Mini-grid, SHS1, SHS2, or the Total). Then you can find the WACC, NPV, and IRR of the project. There are 7 scenarios the end user can analyze: Mini-grid, SHS1, SHS2, SHS1 + SHS2, Mini-grid + SHS1, Mini-grid + SHS2, and Total. The end user can select the scenario he wants to analyze thanks to the graphs, KPI calculation, and value table.

BE AWARE THAT THIS SHEET WILL ONLY DISPLAY RESULTS IF ALL THE REQUESTED FIELDS IN THE CONTROL TABLE SHEET MUST BE COMPLETED.

General commands

1. Select one of the scenarios: Total
5. Download

Project Performance, KPIs for different scenarios

WACC	11.21%
NPV (MGN)	68 067 333
LCOE	163.702101
ROI	49.48%
IRR	15.84%
Total Scenario Revenue	2669660677

Systems Results

3. Click to see the Mini Grid Results
- Click to see SHS1- 25 years Results
- Click to see SHS1- 5 years Results
- Click to see SHS2- 25 years Results

Graphs

4. NUMBER OF USERS: Evaluation of users for electrification for each scenario as a function of variation in demand. Details of the type of users for SHS (changed batteries or new systems) are given. Show number of users
- REVENUE: Refers to the total amount of money earned or generated over the years, which is therefore linked to the number of users. Distribution of the revenues according to the scenario. Show Revenue
- INVESTMENT: Investment is the act of allocating money or resources with the expectation of generating income. Distribution of investment between CapEx and OpEx, as well as among the different systems. Show Investment
- OPEX: The Operational Expenditure refers to the expenditures that a company bears in order to maintain its daily operations. Focus on the breakdown of OpEx, to visualize the difference between SHS and batteries. Show OPEX
- CAPEX: CapEx refers to substantial company to enhance its assets. Distribution of the CapEx according to the different systems. Show CAPEX

Figure 35: Simulation Results interface

5.3.1 Scenario choice

Firstly, the user can choose the desired scenario by utilizing a dropdown list.

As a reminder, the 7 scenarios are:

1. *Mini-grid*
2. *SHS1*
3. *SHS2*
4. *Mini-grid + SHS1*
5. *Mini-grid + SHS2*
6. *SHS1 + SHS2*
7. **Total:** *Mini-grid + SHS1 + SHS2*

Based on the user's scenario selection, all the representations in the subsequent simulation and results sheet will be modified. This choice is crucial as the outcomes can vary significantly depending on the scenarios. However, the selection can be modified in case of an error, for comparison purposes, or out of curiosity. Simply expand the dropdown list and choose the desired scenario.

5.3.2 Key Performance Indicators (KPIs) and Project Performances

Key Performance Indicators and the performance of the selected scenario will be displayed. Each of these pieces of information is accompanied by a commentary that redefines the indicator and provides comparison tools or magnitudes for better understanding.

The different KPIs and project performances available are :

1. WACC
2. NPV
3. LCOE
4. ROI
5. IRR
6. Total Scenario Revenue

5.3.3 System Results

Similarly to the control table, the results for each system are available for consultation. As mentioned before, the user needs to click on the button corresponding to the system, and this will take them to the relevant sheet.

These sheets are also described in the section [5.4](#) later in the manual.

Here, the sheets 'Indexation and Financing' and 'Mini-grid Depreciation' are not directly accessible, but they can be found within other sheets. The user can also access them directly from the control table, and they are listed in the table of contents for easy navigation.

5.3.4 Visualisation of the Graphs and Diagrams

It will be possible to visualize the graphs and diagrams. There are seven different sections: *Number of users and SHS utilization, Revenues, Investment, Operating Expenses (OpEx), Capital Expenses (CapEx), Net Cash Flows, Cumulated Cash Flows*

Each section contains graphs. After reading the brief description within the boxes, if the user wishes to display specific data, they simply need to click on the checkbox, and the section will appear.

Each section is structured as follows:

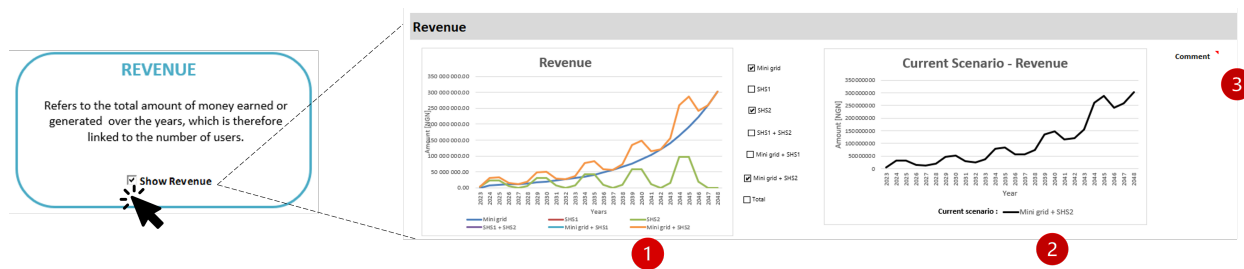


Figure 36

All scenarios graph In each section, there is a graph representing the evolution of the chosen variable (number of users, revenues, etc.) over the years for each scenario. It is up to the user to choose which scenario they want to visualize. They simply need to uncheck the checkboxes of the scenarios they do not wish to display. For example, in the studied case, the scenario is Mini-grid + SHS2. Therefore, the revenues for this scenario should be displayed. However, it can be interesting to estimate the proportionality of revenues for each system while keeping Mini-grid and SHS2.

The graph of the current scenario allows the user to understand which scenario they are viewing and can understand the evolution of the variable over the years.

Comment is provided to ensure that the user has a clear understanding of the variable they are visualizing. The commentary includes a definition of the variable and information about the calculation methods employed. It may also provide insights to help the user better comprehend the evolution of the variable.

The content of each section is specific to its purpose and serves a particular role.

1. Number of users and SHS utilization

Curves describe the evolution of the number of users for each scenario as a function of variation in demand. The detail of the type of users for SHS (changed batteries or new systems) is given.

2. Revenues

Refers to the total amount of money earned or generated over the years, which is therefore linked to the number of users. Some curves describe the distribution of the revenues according to the scenario.

3. Investment

Investment is the act of allocating money or resources with the expectation of generating income. Some curves describe the distribution of investment between CapEx and OpEx, as well as among the different systems.

4. Operating Expenses (OpEx)

The Operational Expenditure refers to the expenditures that a company bears in order to maintain its

daily operations. Here the focus is on the breakdown of OpEx, to allow the user to visualize the difference between SHS and batteries OpEx.

5. Capital Expenses (CapEx)

CapEx refers to substantial investments made by a company to enhance its future performance. The distribution of the CapEx according to the scenario in a histogram.

6. Net Cash Flows

Net cash flows depict the variance between cash inflows and outflows within a designated period. Here, the distribution of the Net Cash Flows according to the scenario is represented using curves.

7. Cumulated Cash Flows

Cumulative cash flows represent the accumulated sum of cash inflows and outflows throughout a specified duration. It is possible to visualize the distribution of the Cumulated Cash Flows according to the scenario through curves.

5.3.5 Download a report

The last section allows the user to download a report presenting the results of the previously selected scenario.

The generic report includes the most important information about the current scenario (most important KPIs, investment, and revenue). The user can download it by clicking on the "Download" button.

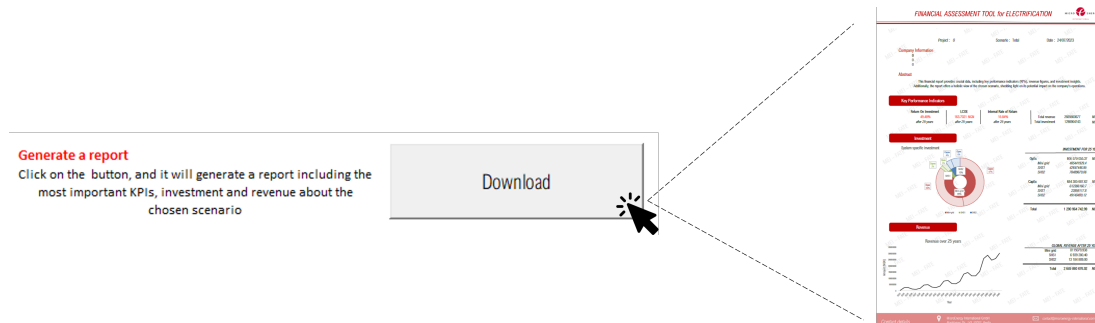


Figure 37: Generic Report

5.4 Spreadsheet results

The spreadsheets do not contain the details of each calculation but rather show intermediate results that are relevant to the user.

There are different types of spreadsheets: the ones which correspond to each scenario independently ("Micro-grid", "SHS1 25 years", "SHS1 5 years", "SHS2 25 years" and "SHS2 5 years") and the complementary sheets ("Indexation and Financing" and "Mini-grid Depreciation").

Users should be reminded that all the calculation sheets are designed to be consulted and must not be modified under any circumstances.

5.4.1 Results about each system

The model for each sheet that gives the intermediate results, i.e. the results for each scenario, all follow a very precise pattern.

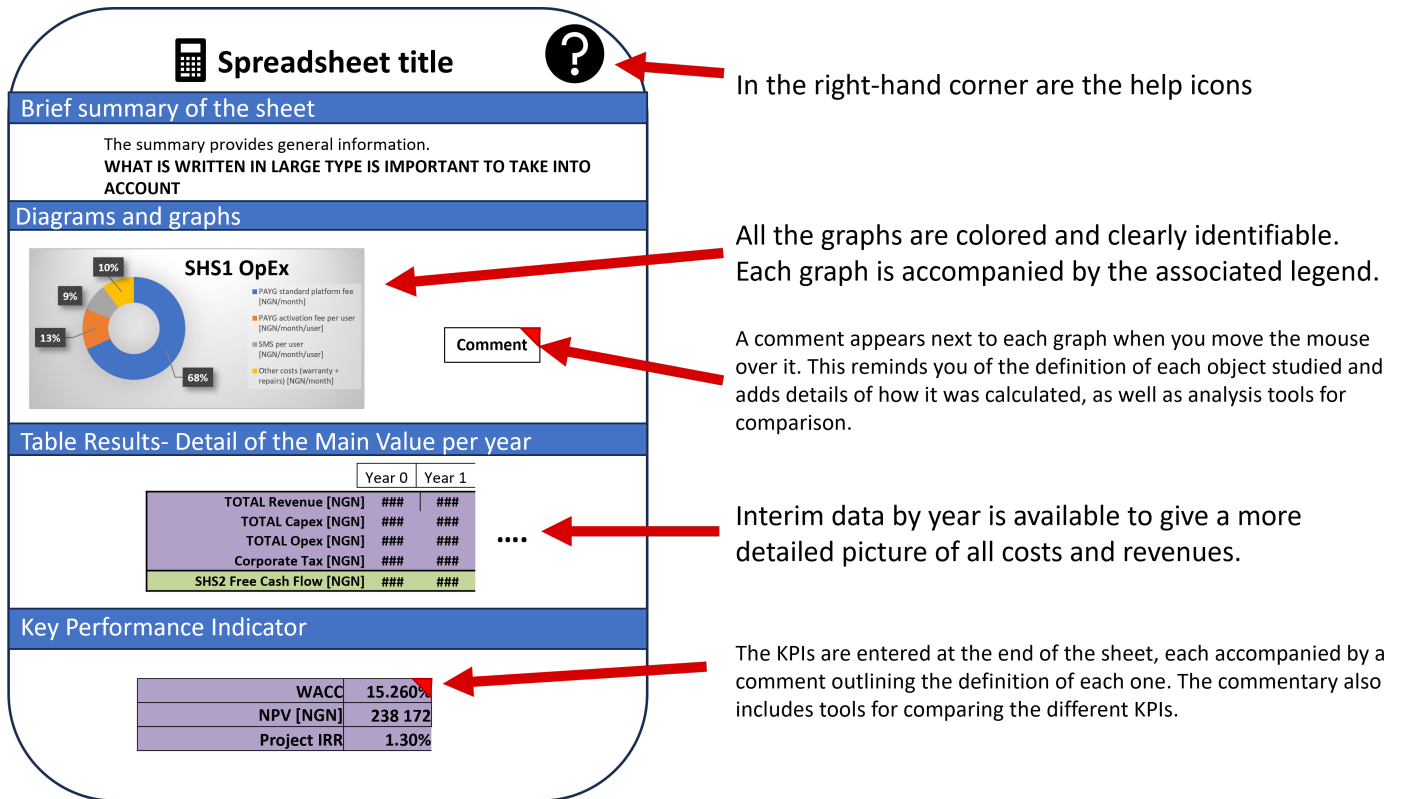


Figure 38: Spreadsheet Model

Given that the figure above is only a model listing all the information on a single page, here it's possible to find below an example of a results sheet related to the employed systems, specifically the Mini-grid results sheet.

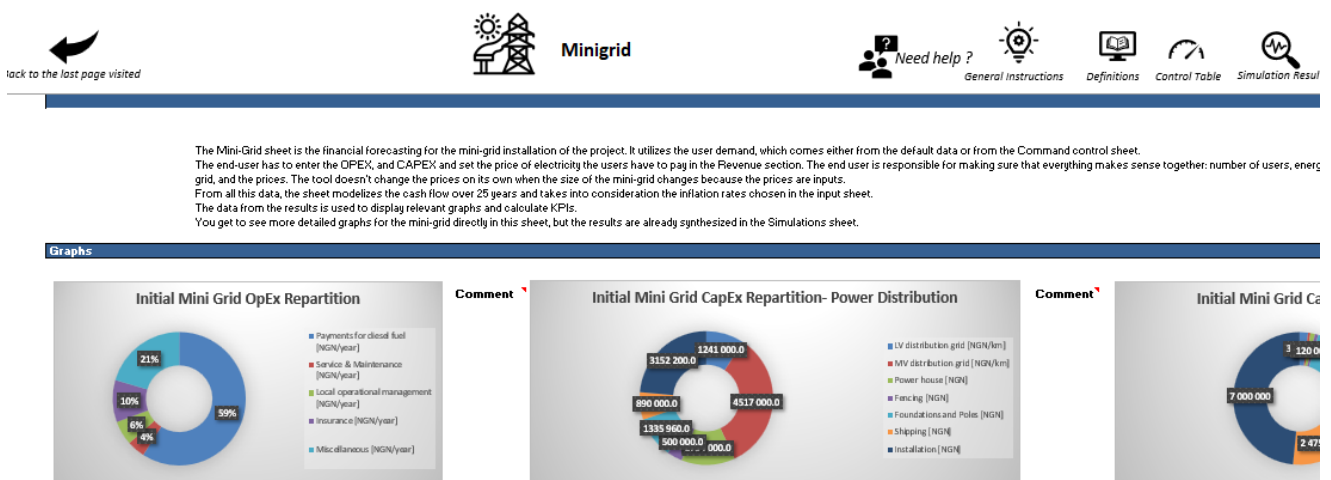


Figure 39: Mini-grid interface

This sheet presents the outcomes and performance indicators specific to the Mini-grid system, including key financial metrics, energy production, revenue generation, operating expenses, capital expenditures, net cash flows, and cumulative cash flows, but also the different graphs associated.

Please note that the provided example is for illustrative purposes and may not reflect the exact format or content of your specific results sheet.

5.4.2 Results in the form of data table

The Indexation and Financing Results sheet is unique as it contains the data tables for all the calculations performed in this section. This sheet provides information on the evolution of costs and revenues, including fixed charges, metering charges, and all projected cost and tax increases for future years.

This sheet sets the different indexation rates you want for the forecasting (inflation, electricity tariff increase, increase in the number of users), and the data on debt and equity which is used to determine the WACC of the project. There is an inflation rate for diesel prices, metering charges, and fixed charges, and there is a general cost inflation rate that is used for everything else.

Data

Starting Year of the Project (Year 0) 2023

Chosen scenario SHS1

Cost and Revenue Indexation

	Indexation[%]
Diesel fuel Price Indexation [NGN/L]	3.80%
General Cost Indexation [%]	10.00%
Fixed charges for residential users [NGN/month/user]	6.50%
Fixed charges for community users [NGN/month/user]	6.50%
Fixed charges for commercial small scale users [NGN/month/user]	6.50%
Fixed charges for commercial large scale & anchor load users [NGN/month/user]	6.50%
Metering charges for residential users [NGN/month/user]	6.50%

For details of the 25 years of indexation and financing details, click on the + at the top right of the AU column

Figure 40: Indexation and financing interface

This sheet is designed for informational purposes and does not need to be modified.

5.5 Summary of the values

The Summary of Values section records the most significant values for each scenario. Similarly to the Indexation and Financing table, the data is presented in tables, allowing users to refer to them for precise result values throughout the period. However, it is not recommended to rely solely on the results provided in this sheet, as the abundance of data can easily lead users to confusion.

Back to the last page visited

Summary of the values Need help? General Instructions Definitions Control Table Simulation Re.

This sheet is not relevant for the end user, it shall not be modified. In this sheet, there is only one table that synthesizes all the values that are used.

Summary of the values		0	1	2	3	4	5	6	7	8	9	10	2
		2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	
Number of users													
Mini grid		0	67	69	70	71	73	74	76	77	79	80	
SHS1		0	106	106	106	106	106	94	94	94	94	94	
SHS2		0	70	70	70	70	70	62	62	62	62	62	
Mini grid + SHS1		0	176	176	176	176	176	156	156	156	156	156	
Mini grid + SHS2		0	173	175	176	177	179	168	170	171	173	174	
SHS1 + SHS2		0	137	139	140	141	143	136	138	139	141	142	
Total		0	243	245	246	247	249	230	232	233	235	236	
Cumulated SHS installed													
[NGN]													
SHS1	0	106	108	110	112	114	117	119	121	123	125		
SHS2	0	70	71	72	73	74	77	78	79	80	81		
SHS1 + SHS2	0	176	179	182	185	188	194	197	200	203	206		
Mini grid + SHS1	0	106	108	110	112	114	117	119	121	123	125		
Mini grid + SHS2	0	70	71	72	73	74	77	78	79	80	81		
Total	0	176	179	182	185	188	194	197	200	203	206		
New users of SHS													
[NGN]													
SHS1	0	106	108	110	112	115	11	13	15	17	19		
SHS2	0	70	71	73	74	76	7	8	9	10	11		
SHS1 + SHS2	0	176	179	183	186	191	18	21	24	27	30		
Mini grid + SHS1	0	106	108	110	112	115	11	13	15	17	19		
Mini grid + SHS2	0	70	71	73	74	76	7	8	9	10	11		
Total	0	176	179	183	186	191	18	21	24	27	30		

Figure 41: Summary of the values interface

5.6 Table of contents

WARNING: This sheet is *facultative*, if the user wants to access it, they have to select the specific sheet in the 'Introduction and General Instruction'. The user can refer to the section 4.1 and 5.1 for a better understanding of this tool.

Back to the last page visited

Table of Contents Need help? General Instructions Definitions Control Table Simulation Result.

This section references all the different sheets and contents of this Excel tool. You can go directly to each sheet by clicking on its name. However, it is advisable to read the introduction and the general commands, the assumptions, and finally to complete the command control sheet to see the results in the other sheets.

Introduction & General Instructions
1. General Instructions <i>Different tools and types of cells</i>
2. List of abbreviations and definitions <i>Technical, Financial Abbreviations and Definitions</i>
Assumptions
1. General assumptions
2. Mini grids assumptions
3. Depreciations assumptions
4. Solar Home System (SHS) Assumptions

Figure 42: Table of content interface

The table of contents allows the user to navigate the structure of the tool. First, each sheet is summarized to the user, it is detailed exposing its different sections, and then highlighted by the content. It is possible to directly access the relevant sheet by clicking on the title of the worksheet or section.

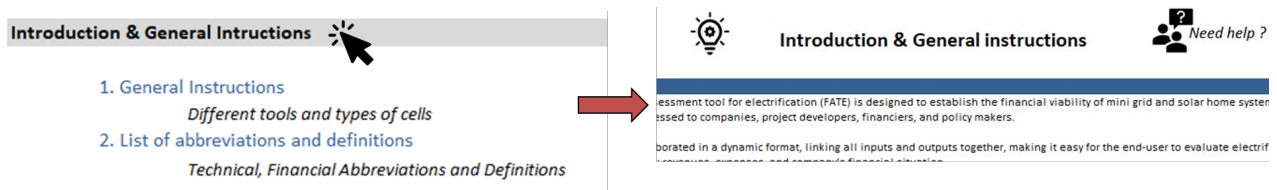


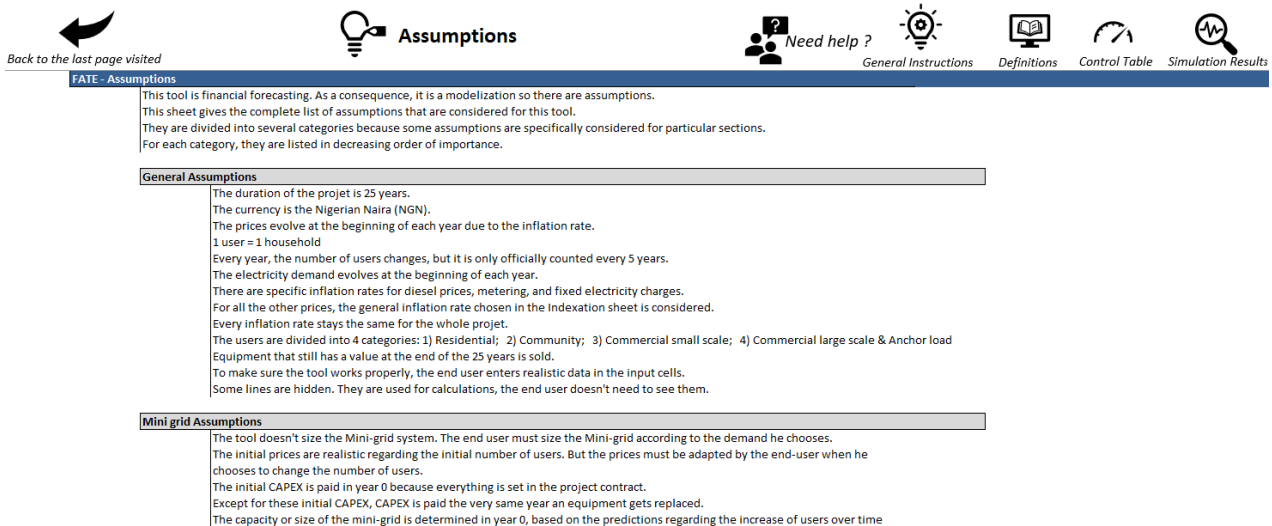
Figure 43: Functioning of hyperlinks

The hyperlinks enable easier navigation to the specific content that the user wishes to study. In case of

accidental clicking, the back arrow can be used to return to the table of contents.

5.7 Assumptions

WARNING: This sheet is *facultative*, if the user wants to access it, they have to select the specific sheet in the 'Introduction and General Instruction'. The user can refer to the section 4.1 and 5.1 for a better understanding of this tool.



Back to the last page visited

Assumptions

Need help ?

General Instructions

Definitions

Control Table

Simulation Results

FATE - Assumptions

This tool is financial forecasting. As a consequence, it is a modelization so there are assumptions. This sheet gives the complete list of assumptions that are considered for this tool. They are divided into several categories because some assumptions are specifically considered for particular sections. For each category, they are listed in decreasing order of importance.

General Assumptions

- The duration of the projet is 25 years.
- The currency is the Nigerian Naira (NGN).
- The prices evolve at the beginning of each year due to the inflation rate.
- 1 user = 1 household
- Every year, the number of users changes, but it is only officially counted every 5 years.
- The electricity demand evolves at the beginning of each year.
- There are specific inflation rates for diesel prices, metering, and fixed electricity charges.
- For all the other prices, the general inflation rate chosen in the Indexation sheet is considered.
- Every inflation rate stays the same for the whole projet.
- The users are divided into 4 categories: 1) Residential; 2) Community; 3) Commercial small scale; 4) Commercial large scale & Anchor load
- Equipment that still has a value at the end of the 25 years is sold.
- To make sure the tool works properly, the end user enters realistic data in the input cells.
- Some lines are hidden. They are used for calculations, the end user doesn't need to see them.

Mini grid Assumptions

- The tool doesn't size the Mini-grid system. The end user must size the Mini-grid according to the demand he chooses.
- The initial prices are realistic regarding the initial number of users. But the prices must be adapted by the end-user when he chooses to change the number of users.
- The initial CAPEX is paid in year 0 because everything is set in the project contract.
- Except for these initial CAPEX, CAPEX is paid the very same year an equipment gets replaced.
- The capacity or size of the mini-grid is determined in year 0, based on the predictions regarding the increase of users over time

Figure 44: Assumptions interface

All the assumptions made during the development of this tool are explained and detailed in this sheet. It is important to take them into account to understand the tool.

5.8 Default data

WARNING: This sheet is *facultative*, if the user wants to access it, they have to select the specific sheet in the 'Introduction and General Instruction'. The user can refer to the section 4.1 and 5.1 for a better understanding of this tool.

The default data sheet corresponds to the request of a village in Nigeria with approximately 250 inhabitants who access energy through Mini-grid, SHS1, and SHS2. It is provided to users as a reference for understanding the tool with a concrete example. This allows users to grasp how the tool functions and subsequently apply it to their data.

Please note that these default data are sourced from WP3 & 4 of the PeopleSuN project.

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Default data

Need help? General Instructions Definitions Control Table Simulation Results

This is the demand data coming from a real village. In the dashboard, the end-user can choose to use this data to use the sheet with a real-life example. That way, the end user can understand what the tool does more easily before entering his demand data. This default data comes from WP3&4 of PeopleSUN.

FATE - Default data

Demand Data*		
Consumer Sector	Energy in kWh/day	Energy in %
Residential	307.9165	37.28%
Community	302.64	36.64%
Commercial Small Scale	118.81	14.38%
Commercial Large Scale	58.2	7.05%
Anchor Load	38.4	4.65%
Total Daily energy demand	825.9665	100.00%
Energy produced by user	3.413085	

*This data is coming from previous project. It will be replaced with data (TO BE RECEIVED) from WP3

	Tier Wise energy demand Demand(kWh/day)	Number Of customers	Energy in %	Recommended Solution
Residential Demand	Tier 1 & Tier 2	154.6295	57	18.72%
	Tier 3	90.99	25	11.02%
	Tier 4 & Tier 5	62.297	24	7.54%
Community Demand	Tier 1 & Tier 2	119.2	26	14.43%
	Tier 3	78.5	28	9.50%
	Tier 4 & Tier 5	104.94	18	12.71%
Commercial Small Scale	Tier 1 & Tier 2	72.25	23	8.75%
	Tier 3	25.69	8	3.11%
	Tier 4 & Tier 5	20.87	7	2.53%

From existing demand estimation			
Recommended solution wise Demand in %	Number of Customers	kWh	
SHS 1	41.90%	106	34
SHS 2	27.07%	70	
Mini Grids	31.03%	66	

Figure 45: Default Data interface

5.9 References

WARNING: This sheet is *facultative*, if the user wants to access it, they have to select the specific sheet in the 'Introduction and General Instruction'. The user can refer to the section 4.1 and 5.1 for a better understanding of this tool.

The bibliography is an important section of this tool and offers numerous benefits. It provides a list of bibliographic references that have been used as sources of information to develop the calculations and methodologies of this tool.

The bibliography allows you to deepen your knowledge in the field of off-grid electrification, particularly in Nigeria, by consulting the cited sources. Each reference provides you with the opportunity to further explore the concepts, theories, and models that underlie this tool.

Back to the last page visited

References

Need help? General Instructions Definitions Control Table Simulation Results

List of references used for this tool.

List of references

Adam Hayes. 'Investment Basics Explained With Types to Invest In'. Investopedia. [Updated March 16, 2023] <https://www.investopedia.com/terms/i/investment.asp>

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Chris, Ochayi. 'NERC Unveils New Electricity Tariff, Abolishes Fixed Charge'. Vanguard News (blog). [Published December 21, 2015]. <https://www.vanguardngr.com/2015/12/nerc-unveils-new-electricity-tariff-abolishes-fixed-charge/>

Client II. 'PeopleSuN - Optimierung von Off-Grid Energieversorgungssystemen in Nigeria'. [n. d., Accessed 11 July 2023] <https://www.bmf-client.de/index.php/projekte/peoplesun>

Dang, Tony. 'DCF vs NPV: What's the Difference?' Clifcore (blog). [January 3, 2022] <https://clifcore.com/DCF-vs-npv-whats-the-difference/>

Figure 46: References interface

The bibliography establishes a solid foundation for using this tool. The cited references have been carefully selected to ensure the quality and reliability of the information used.

6 Help

In this section, common problems that users may encounter are listed, along with potential solutions.

I do not want to consider the Mini-grid system in my calculations. How can I proceed?

To get all the information concerning the exclusion of a specific system, section 5.2.4 references the functioning of the associated tool.

If you do not wish to include the Mini-grid system in your calculations, you can simply check the box "Do not consider the Mini-grid system" when filling out the control table. This checkbox is located at the top right of each main section, in front of the system name.

By excluding the Mini-grid system, you can focus solely on the calculations and analysis related to the remaining systems (e.g., SHS1, SHS2).

Please note that if all three systems (Mini-grid, SHS1, SHS2) are excluded, it will not be possible to run the tool.

I am missing some data to fill in the control table. What should I do?

When considering a scenario, ALL cells corresponding to that scenario must be filled to run the tool successfully. Otherwise, the calculations will be distorted due to the absence of a certain value, as it will be considered zero.

The cells are categorized by a color code, which was explained earlier (section 4.4): (*Yellow cells: users are asked to enter the data they have available. This is the most important data, so it must be chosen with care, and particular attention must also be paid to the units. Yellow light cells: Data must also be entered in these cells. Particular attention must be paid to the units.*) It is important to note that values expected in the yellow cells are of high importance and should be carefully selected.

For each value that needs to be entered, value scales are provided to help the user estimate or determine the appropriate values.

Alternatively, the user can utilize the previously entered values, which are set as default values.

I want to add a category, a value that is specific to my case. How can I do that?

While FATE is freely accessible, it is not open for modification at the structural level. To enable such modifications, you would need to request the developers of the tool to provide this service.

I want to create a chart that is not available in the result sheets, how can I do that?

It is not possible to directly create new charts within the result sheets. But, if you want to create a chart that is not available in the result sheets, you can follow these steps:

1. Identify the specific data you need for your chart. You can obtain it from the summary of values or directly from the calculation sheets.
2. Transfer the data to a new Excel file. Organize the data appropriately to create the desired chart.
3. Select the range of data you want to include in the chart.

4. Use Excel's chart creation capabilities to create your custom chart. Excel offers a variety of chart types and customization options to visualize the data in the desired format.
5. Customize the chart by adding labels, titles, axes, and other formatting options to enhance clarity and visual appeal.

7 Glossary

The glossary's purpose is to allow explanations of technical terms or specific acronyms, explaining their meaning to make it easier for users to understand.

CapEx: Capital Expenditure refers to substantial investments made by a company to enhance its future performance. Typically, capital expenditures are directed towards fixed assets such as property, plant, and equipment to bolster the company's overall operations and effectiveness in the long run.

Cummulative Cash flows: It represents the accumulated sum of cash inflows and outflows throughout a specified duration. They provide a continuous record of the net impact resulting from cash receipts and expenditures up until a particular moment. By considering all preceding cash flows, cumulative cash flows offer a comprehensive perspective of the overall cash position and performance over the designated timeframe. They serve as a valuable tool for monitoring the cumulative influence of cash inflows and outflows on the financial status of an individual, company, or entity.

DCF: Discounted Cash Flows is a valuation approach utilized to assess the worth of an investment by discounting the projected future cash flows. This method applies to various assets or activities, including stocks, companies, projects, and more, making it extensively employed in the investment industry and corporate finance management. DCF analysis takes into account the time value of money, considering that a dollar received in the future holds less value than a dollar received today. By discounting the anticipated cash flows back to their present value using an appropriate discount rate, DCF enables decision-makers to evaluate the attractiveness and profitability of investment opportunities.

$$DCF = \sum_{i=1}^k \frac{CF_i}{(1 + WACC)^t} \quad (1)$$

With :

- CF: Cash Flows
- t: Period
- WACC: Weighted Average Cost of Capital

Investment: Investment is the strategic allocation of funds, resources, or capital to generate long-term income, profit, or value growth. It involves deploying financial assets across a variety of instruments, projects, or assets to achieve desired financial objectives and acquire ownership or control. Investments encompass a broad range of opportunities, including stocks, bonds, real estate, businesses, and other assets that offer the potential for returns and value appreciation.

IRR: The Internal Rate of Return (IRR) is a financial metric utilized to assess prospective investments' profitability. It represents the discount rate at which the net present value (NPV) of all cash flows becomes zero in a discounted cash flow analysis. The IRR serves as an annualized rate of growth expected from an investment. The calculation of IRR employs the same formula as NPV. It should be noted that IRR does not provide the actual monetary value of the project but rather the annual rate of return that renders the NPV equal to zero.

$$NPV = \sum_{i=0}^k \frac{CF_i}{(1 + IRR)^t} = 0 \quad (2)$$

With :

- CF: Cash Flows, with CF_0 , the initial outlays
- t: Period
- NPV: Net Present Value

KPI: Key Performance Indicator is a metric used to measure the performance of work undertaken towards specific objectives, providing insights into whether those objectives are being achieved. They are critical statistics related to the work or project that help assess whether the marketing strategy being employed is effectively driving the defined goals. KPIs enable the tracking of overall results from the actions taken, revealing which strategies are effective. In this context, the chosen KPIs are NPV (Net Present Value), WACC (Weighted Average Cost of Capital), and project IRR (Internal Rate of Return).

LCOE: The Levelized Cost of Electricity (LCOE) is a metric that enables the evaluation and comparison of the cost of electricity generation across diverse sources or technologies throughout a power plant's lifespan. It provides an average cost estimation for generating a single unit of electricity within a specific power generation project. Through LCOE calculations, different energy sources can be compared in terms of their cost competitiveness.

The LCOE takes into consideration several factors, including initial capital expenses, operational and maintenance costs, potential fuel expenses (if applicable), and the projected energy output over the power plant's entire lifespan. The LCOE formula involves dividing the total lifecycle costs of a power plant by the projected amount of electricity generated throughout its operational years.

$$LCOE = \frac{\text{Total lifetime cost}}{\text{Total lifetime output}} \quad (3)$$

$$LCOE = \frac{\sum \frac{I_t + M_t + F_t}{(1+WACC)^t}}{\sum \frac{E_t}{(1+WACC)^t}} \quad (4)$$

It is important to note that while the LCOE serves as a valuable tool for cost analysis, other factors such as environmental impact, grid integration, resource availability, and policy considerations should also be taken into account when making informed decisions about energy generation investments.

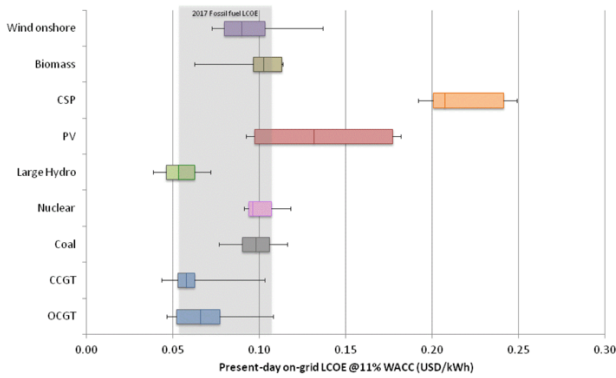


Figure 47: LCOE range for on-grid energy sources ($WACC = 11\%$)

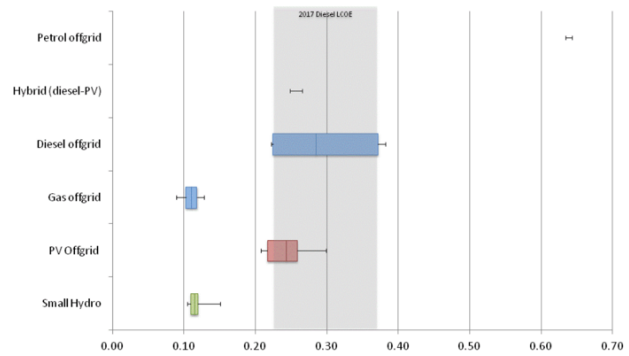


Figure 48: LCOE range for off-grid energy sources ($WACC = 11\%$)

Mini Grid: Is a localized electricity distribution system that serves a cluster of buildings or a small community. It encompasses a central power generation source, such as solar panels or a small diesel generator, along with energy storage systems and a distribution network. The primary objective of mini-grids is to offer reliable and sustainable electricity to fulfill the power requirements of the connected community. They possess greater resilience and capacity to support higher energy demands compared to individual solar home systems. Compared to conventional grid infrastructure, mini-grids are significantly smaller in scale. Typical mini-grid plant sizes range from 10 to 35 kWp for solar capacity and less than 100 kWh for battery energy storage, serving 150 to 400 connections.

Net Cash flows: Represents the variance between cash inflows and cash outflows within a designated period. They exemplify the net quantity of cash that is either generated or expended by an individual, company, or entity over the specified duration. Net cash flows hold significance in assessing the liquidity and financial well-being of an entity as they reflect the overall cash position and the capacity to fulfill financial obligations.

$$NCF = \sum_i^k CF_i = CFO + CFI + CFF \quad (5)$$

With:

- CFO: Cash Flows for Operating Activities
- CFI: Cash Flows for Investing Activities
- CFF: Cash Flows for Financing Activities

NPV: Net present value (NPV) is employed to determine the present worth of anticipated future cash flows from a company, project, or investment. To calculate NPV, one must estimate the timing and magnitude of future cash flows and select a discount rate that equals the minimum acceptable rate of return. The chosen discount rate can encompass the cost of capital or the potential returns from alternative investments with comparable risk. A positive NPV indicates that the project or investment will yield a rate of return exceeding the discount rate.

$$NPV = \sum_{i=0}^k \frac{CF_i}{(1 + WACC)^t} \quad (6)$$

With :

- CF: Cash Flows, with CF_0 , the initial outlays
- t: Period
- WACC: Weighted Average Cost of Capital

OpEx: Operational Expenditure refers to a company's expenditures to maintain its daily operations. These expenses specifically exclude any costs directly associated with the production of goods or services.

PAYG: The "Pay As You Go" business model has emerged as a solution to tackle the issue of limited access to energy, aiming to offer affordable electricity generated from renewable energy sources. This model leverages available technologies in the respective areas to facilitate payments. The widespread adoption of mobile payment technologies, abundant solar resources, and decreasing costs of solar PV and batteries, alongside growing awareness of these technologies, have played a vital role in driving the implementation of this innovative business model.

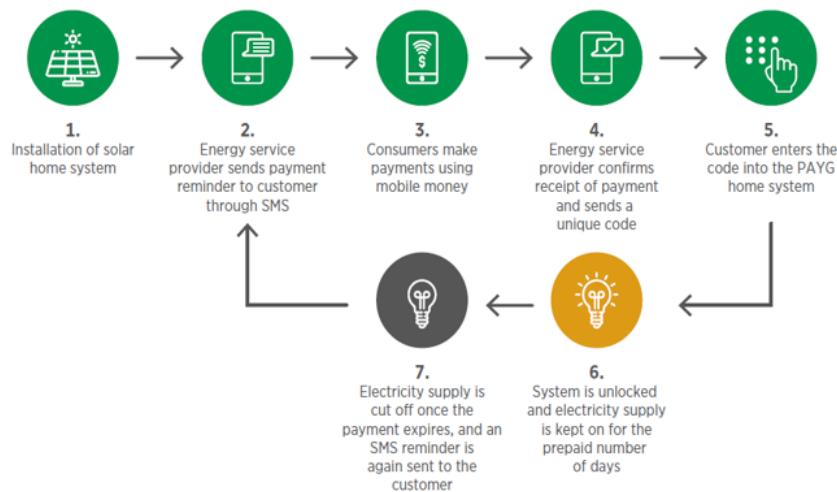


Figure 49: Schematic taken from the IRENA's report (2020), Innovation landscape brief: Pay-as-you-go models, International Renewable Energy Agency, Abu Dhabi.

Revenue: It refers to the amount of money or earnings generated by an individual, company, or entity during a specific period. They represent the financial inflows originating from various sources. They serve as a key indicator of an entity's economic and financial performance.

ROI: The Return on Investment is a financial metric used to evaluate the profitability or efficiency of an investment. ROI measures the return or gain generated from an investment relative to its cost.

The ROI formula is:

$$ROI = \left(\frac{\text{Net Profit}}{\text{Cost of Investment}} \right) \quad (7)$$

With:

- Net Profit refers to the financial gain calculated as the revenue
- Cost of Investment represents the total investment cost

ROI is used as a benchmark to assess the success or failure of an investment. A higher ROI indicates a more favorable return relative to the investment cost, while a lower ROI suggests a less profitable or inefficient investment.

SHS: The Solar Home System (SHS) is an independent solar power setup intended to fulfill the electricity requirements of an individual household or a small business. SHS primarily delivers DC power. It comprises solar panels, a battery for storing energy, and a charge controller. These systems are installed directly at the user's premises and provide electricity for lighting, charging small devices, and operating low-energy appliances. They are relatively smaller in size and are well-suited for off-grid locations or areas with restricted access to the primary power grid.

WACC: The Weighted Average Cost of Capital (WACC) represents the combined cost of various sources of capital for a company, including common shares, preferred shares, and debt. Each type of capital's cost is weighted based on its proportion in the total capital structure, and these weights are then aggregated.

The WACC is the discount rate utilized in calculating a business's Net Present Value (NPV). It is also employed to assess investment opportunities since it reflects the firm's opportunity cost. In evaluating mergers and acquisitions, as well as for financial modeling of internal investments, companies commonly use their WACC as a hurdle rate. If an investment opportunity yields a lower Internal Rate of Return (IRR) than the company's WACC, it indicates that the company should consider alternatives such as share buybacks or dividend payouts rather than investing in the project.

$$WACC = \left(\frac{E}{V} \cdot Ce\right) + \left(\frac{D}{V} \cdot Cd\right) \cdot (1 - T) \quad (8)$$

With :

- Ce: Cost of Equity
- Cd: Cost of Debt
- V: total value of capital
- E: market value of the firm's equity
- $\frac{E}{V}$: Equity ratio
- D: market value of the firm's debt
- $\frac{D}{V}$: Debt ratio
- T: Corporate income tax

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9 Appendix

Appendix 1: fosera SPARK - Datasheet

Appendix 2: fosera IGNITE - Datasheet

fosera® SPARK

2 LIGHTS & USB FOR PHONE CHARGING
PAYG ENABLED WITH INTEGRATED KEYPAD
SIMPLE AND POWERFUL



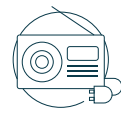
lights



phone charging



PAYG



radio
**optional*

The **fosera**® SPARK is the perfect entry level solar home system, designed to be cost effective and ultra-efficient while maintaining the same high quality standards that **fosera**. is known for.



MAIN FEATURES



x2

SUPERIOR BATTERY RUNTIME

Charge more phones and have longer hours of light



QUALITY

Outstanding quality allowing us to offer the longest warranty in the market: 3 years.



HIGHLY EFFICIENT BATTERY

fosera. uses LiFePO4-batteries, highly efficient and resistant to capacity losses



SUPERIOR BATTERY PROTECTION

Short-circuit, over-current and ESD protection, providing a maintenance-free lifespan of up to 10 years



PAYG WITH SOLID ANTI-TAMPERING MEASURES

Prevention from unlocking PAYG, anti-theft screws, warranty seal



fosera® SPARK	10	20	30	units
Nominal System Voltage	3.2			V
System capacity	3.8	7.6	11.4	Ah
Energy capacity	12.16	24.32	36.48	Wh
Battery type	LiFePO4			
Protection features	Overcharge, overcurrent, deep discharge, short circuit			
Appliance outlets	2x Regular outlets max. 3A			
USB outputs	1x 1A USB output			
Input	1x Solar input max. 2.75A			
Weight	216	302	338	g
Dimensions	130 x 95 x 51			mm
PAYG (optional)	PAYG enabled			

SOLAR PANEL

Module peak power	4	6	10	Wp
Module current (Impp)	0.90	1.33	1.90	A
Module technology	Polycrystalline silicon			
Cable length panel to box	6			m
Module dimensions	180x180x15	270x192x17	340x230x17	mm
Module weight	580	200	1250	g

LAMP MINI

	100	150	
Brightness	100	150	lm
Power	0.76	1.14	W
Cable length	6	6	m

OPERATION TIME

Solar runtime* <i>With 2x Lamp mini 100 at 100%</i>	6:30 hrs	11:20 hrs	16:15 hrs
Solar runtime* <i>With 2x Lamp mini 150 at 100%</i>	4:20 hrs	7:30 hrs	10:50 hrs

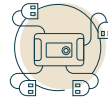
*additional phone charging will reduce the runtime



fosera[®] IGNITE



POWERFUL, HIGH QUALITY SOLAR HOME SYSTEM



MULTIPLE APPLIANCES AVAILABLE, LIKE TV, COOLER OR FAN



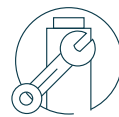
UP TO 243 Wh STORAGE AND 150 Wp OF SOLAR POWER

The fosera. IGNITE can meet all needs of an Off-Grid household, ranging from light to TV, fan to food cooling.



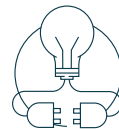
PAYG WITH ENHANCED FLEXIBILITY

Flexibility to change PAYG provider - even during field operations, without any hardware swap



SUPERIOR SYSTEM QUALITY AND PROTECTION

short-circuit, over-current and ESD protection, allowing maintenance-free operation and a 3-year warranty



SMART ENERGY MANAGEMENT

Programmable outlets and load communication to optimize the daily runtime



RELIABLE LITHIUM-IRON-PHOSPHATE BATTERY

Significantly longer battery lifetime compared to Lithium NMC and safer to use



PAYG WITH SOLID ANTI-TAMPERING MEASURES

Prevention from unlocking PAYG, security screws, warranty seal



ENHANCED LAMPS

With touch switch, 3 dimming levels and up to 400 lumens with an efficiency of 145 lm/W



fosera® IGNITE



outputs
x7



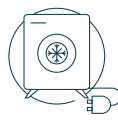
phone
charging



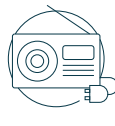
TV
optional



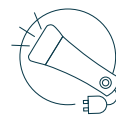
standing fan
optional



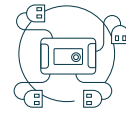
cooler
coming soon



radio
optional



torch
optional



flexible
design



PAYG

TECHNICAL SPECIFICATIONS

fosera® IGNITE	50	100	150	200	250	units
Nominal system voltage	12.8					V
Battery capacity	3.8	7.6	11.4	15.2	19.0	Ah
Battery energy capacity	48.6	97.3	145.9	194.6	243.2	Wh
Battery type	LiFePO4					
Protection features	Overcharge, deep discharge, overcurrent, short circuit					
Appliance outlets	5x 3A regular 1x 3A configurable 1x 4A high power		5x 3A regular 1x 3A configurable 1x 8A high power			
Appliance outlets total current	3.8	8.0				A
USB outputs	2x 2A USB / Max. 2A total					
Max. input current	3.8	8.0				A
Weight	1.00	1.41	1.78	2.17	2.53	kg
Dimensions	233.0 x 172.5 x 90.0					mm
PAYG (<i>optional</i>)	OpenPAYGO Token					

RECOMMENDED SOLAR PANEL

Module peak power	15	30	50	75	Wp	
Module current <i>I_{mpp}</i>	0.8	1.6	2.8	4.0	A	
Module technology	36 cells polycrystalline silicon					
Cable length panel to box	6					m
Module dimensions	350 x 250 x 17	650 x 340 x 20	670 x 530 x 25	770 x 670 x 30	mm	
Module weight	0.9	2.6	4.2	5.4	kg	

OPERATION TIME

Solar runtime* <i>With 4 Lamp 200</i>	7:20	15:00	25:30	25:30	37:00	hrs
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*additional phone charging will reduce the runtime

