



All ON

Achieving Economies of Scale in the Nigerian Solar Value Chain

Opportunities and Benefits of Upstream Localization

ECONOMIC MODEL MANUAL

Table of Contents

1. About the Model	3
2. Using the Economic Model	8
3. Navigating the SHS Dashboard	14
4. Navigating the Mini-grid Dashboard	31
5. Working with the Main Input Sheet	44



1



About the Model



About the Model

This economic model was developed by SEforALL with the support of AllOn to identify opportunities for efficiencies and economies of scale in the existing solar upstream value chain, outline the prospects for localization (assembly or manufacturing locally in Nigeria) and serve as a useful first analytical step for different public and private stakeholder groups who wish to utilize the tool.

For example, the model assesses the impact of renewable energy industry policies on drivers of solar adoption such as product price. One of the ways it seeks to do this is by sensitizing the impact of importation tariffs and the Nigerian Electrification Project's solar home system (SHS) and mini-grid component subsidies on SHS pricing and mini-grid tariffs. Furthermore, it assesses the impact of other electrification drivers on greenhouse gas emissions savings and the viability of localization i.e., the pricing levels and number of SHS product units that need to be assembled or manufactured locally to make localizing the upstream value chain attractive.

Summarily, the model helps the user understand the effects of public and private sector interventions on key outcome indicators such as number of jobs created, product price, government revenue, and GHG emissions, among others.

Who Might Be Interested in Using this Model?

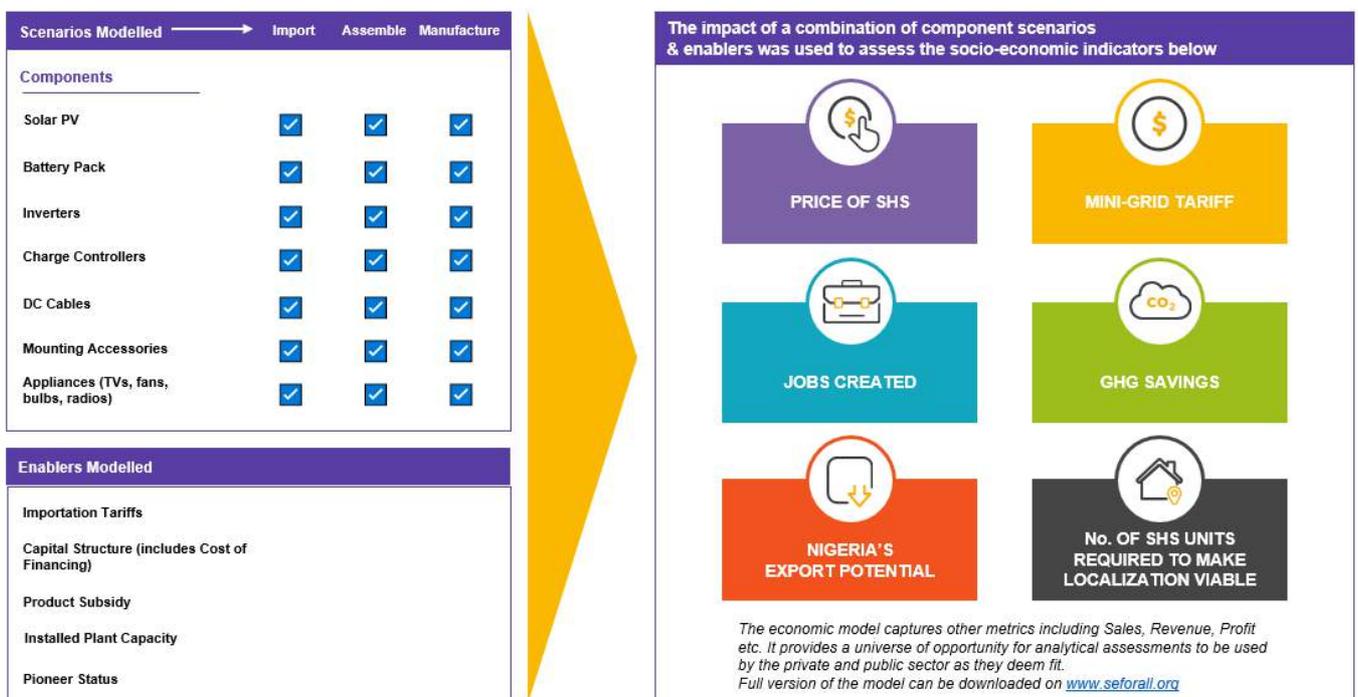
Stakeholder	Sample Use Case
Federal Government of Nigeria/ Rural Electrification Agency	<ul style="list-style-type: none"> Provide macroeconomic analysis to determine the extent to which tariff and taxes impact localization
Component Manufacturers	<ul style="list-style-type: none"> Highlight the impact of scale on the viability of local manufacturing
Component Assemblers	<ul style="list-style-type: none"> Assess the potential cost of assembly for components of a solar system locally
Wholesale SHS Distributors	<ul style="list-style-type: none"> Assess the impact of import tariff waivers on final consumer cost
Mini-grid Developers	<ul style="list-style-type: none"> Assess the impact of subsidies and localization of PVs and batteries on mini-grid tariffs
Financial Institutions	<ul style="list-style-type: none"> Assess the impact of borrowing costs on different localization scenarios and the effects of borrowing on localization in general
Donors	<ul style="list-style-type: none"> Assess the impact of subsidies on localization potential
Other Industry Participants i.e., Green Agencies	<ul style="list-style-type: none"> Evaluate the amount of carbon emission that can be reduced as a result of deploying solar systems
Consultants	<ul style="list-style-type: none"> Create a business case for localization

Where Can You Find the Model and Some of its Keys Outputs

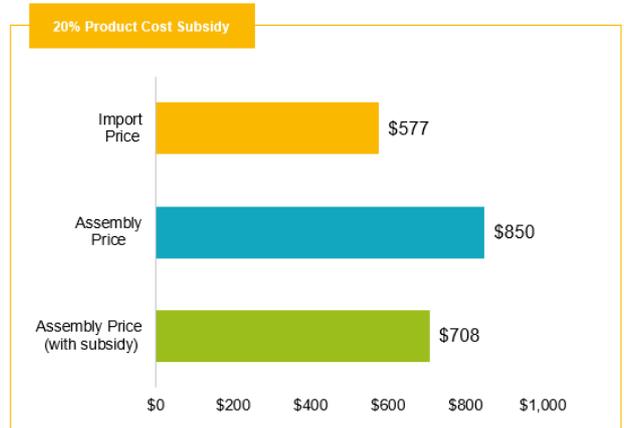
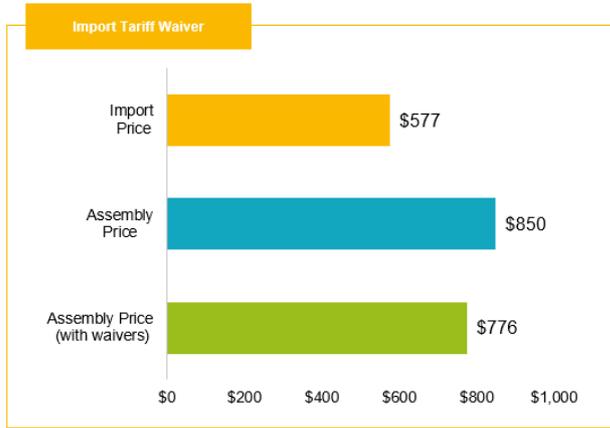
Key outputs of the model were used in the development of the following reports:

1. *Achieving Economies of Scale in the Nigerian Solar Value Chain – Opportunities and Benefits of Upstream Localization*
2. *Achieving Economies of Scale in the Nigerian Solar Value Chain – A Guide for Government and Private Sector*

Sample Model Methodology



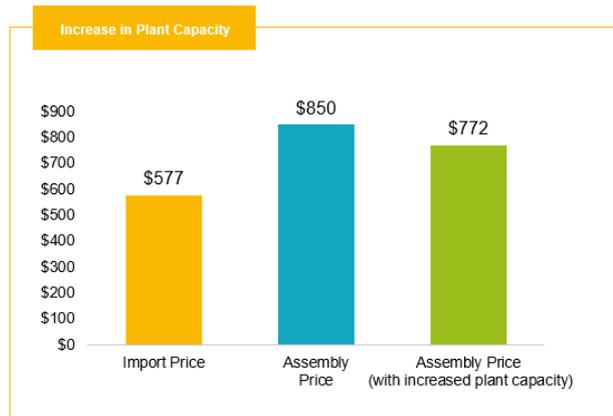
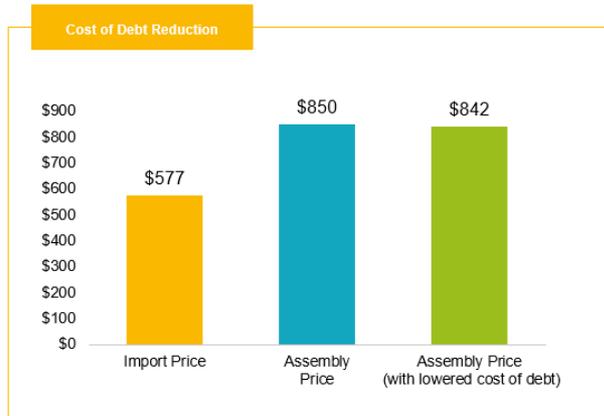
Sample Model Outputs



Action	Full import waiver on all solar components
Results & Impact	Product price of SHS decreases by 9%
	Number of households able to afford system increases by 73%
	Number of units required for localization decreases from 505K to 461K units

Action	20% subsidy on product costs
Results & Impact	Product price of SHS decreases by 17%
	Number of households able to afford system increases by 140%
	Number of units required for localization decreases from 505K to 421K units

Modelled assembly price: price of a 50Wp SHS (battery and PV assembled in Nigeria) with table fan, TV and bulbs from a 20MW capacity plant; locally assembled components – battery & PV
 import tariff reduction: 0% on all SHS system components ; cost of finance reduction: from 12% to 5%; CapEx: Investments: assumes investment in plant capacity from 20M to 100MW; product subsidy: 20% of cost of SHS; 20% sales margin
 Jobs created over 5 years for SHSs and 10 years for mini-grids
 Number of households able to afford is based on Nithio/Fraym geospatial data for homes that can pay at least NGN 5,000 per month, assuming households can transfer 50% of discretionary spending to cover monthly payments
 Impact of localized manufacturing and other scenarios can be assessed from the economic model. See Appendix for link.



Action	Reduce the cost of debt from double digit 12% to 5%
Results & Impact	Product price of SHS decreases by 1%
	Number of households able to afford system increases by 8%
	Number of units required for localization decreases from 505K to 502K units

Action	Increase in plant capacity from 20MW to 100MW
Results & Impact	Product price of SHS decreases by 9%
	Number of households able to afford system increases by 77%
	Number of units required for localisation decreases from 505K to 459K units

Modelled assembly price: price of a 50Wp SHS (battery and PV assembled in Nigeria) with table fan, TV and bulbs from a 20MW capacity plant; locally assembled components – battery & PV
 import tariff reduction: 0% on all SHS system components ; cost of finance reduction: from 12% to 5%; CapEx: Investments: assumes investment in plant capacity from 20M to 100MW; product subsidy: 20% of cost of SHS; 20% sales margin
 Jobs created over 5 years for SHSs and 10 years for mini-grids
 Number of households able to afford is based on Nithio/Fraym geospatial data for homes that can pay at least NGN 5,000 per month, assuming households can transfer 50% of discretionary spending to cover monthly payments.
 Please note the impact of cost of debt on SHS product price will be more pronounced on any one single distributor. The reason for the minimal impact here is because we have assumed one distributor for the whole country for the purpose of modelling; as such they are able to spread their interests costs over much larger units of SHS assembled.



2

Using the Economic Model

Using the Economic Model

The model is divided up into two distinct solar system solutions, namely the solar home system (SHS) and the mini-grid, which are modelled with different sets of assumptions to arrive at the objective.

This user guide presents an overview of the model and gives step-by-step instructions on how a user can navigate and make sense of the scenarios presented.

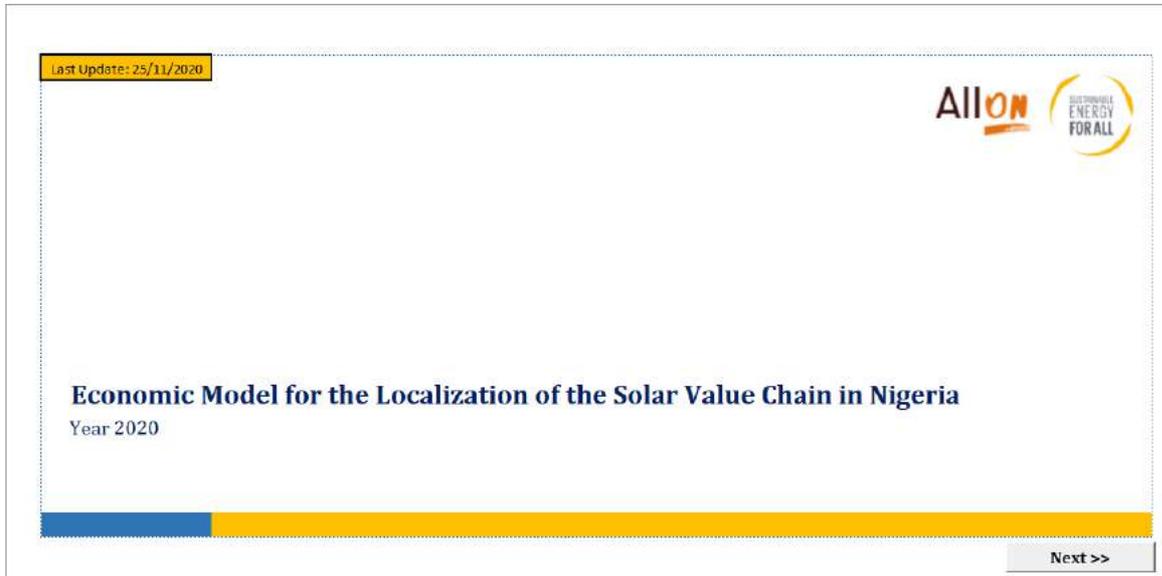
System Requirements

Ensure that your computer meets or exceeds the following system requirements before downloading the model:

CPU	Intel Celeron 800 MHz (Intel Core 2 Duo 2 GHz recommended)
RAM	256 MB (2 GB recommended)
Available disk space	200 MB
Model Application	Microsoft Excel
Model Size	7MB
Operating system	Windows

Exploring the Model

The start page provides a convenient hub to the different sections of the model.



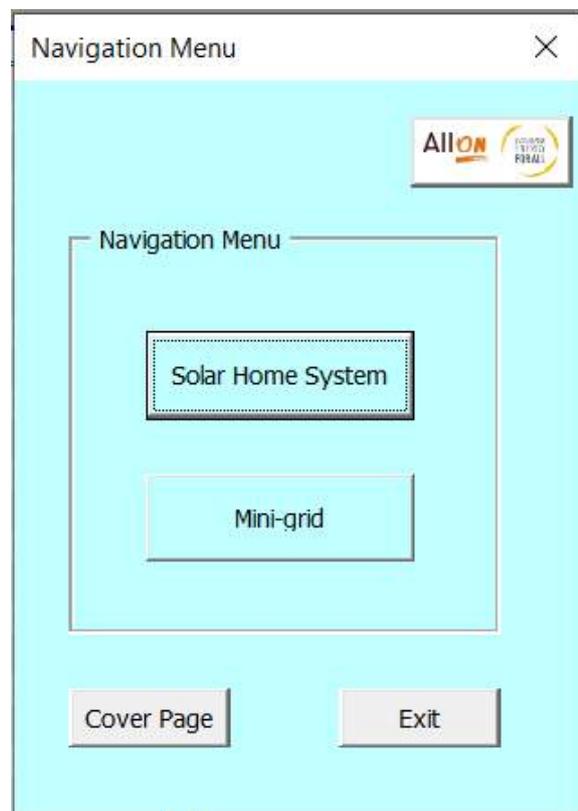
- To start, click the “Next” button on the start page, which immediately navigates the user to the model content page.
- The model content page describes all the available content tabs in the model as seen below. The content page also introduces the navigation menu (to be described in the next chapter).

Key		Navigation Menu
Blue	Input Cells	
Black	Calculated Cells	
Green	Referencing Cells	
Red	Data Validated Cells	
CONTENT		
CoverPg	Cover Page	
Content	Model Page Content	
Main Input Sheet	Combined Assumptions Page	
SHS Dashboard	Dashboard for Solar Home Systems	
M.G Dashboard	Dashboard for Mini-grid	
M.G Tariff Derivation	Mini-grid Assumptions Tariff Derivation Analysis	
M.G Cost Structure	Mini-grid Cost Structure	
M.G Financials	Mini-grid Income, Statement, Cashflow Statement & Financial Position	
Cost Buildup Distributor	Cost Buildup for Importer/Distributor	
Cost Buildup Mfg & Assem	Cost Buildup for Assembler & Manufacturer	
SHS Financials	Solar Home Systems Income Statement & Statement of Cashflow	
Buildup-EcoScale	Buildup Economies of Scale	
Main-DS	Main Debt Schedule	
Mini-grid DS	Mini-grid Debt schedule	
Import SA-DS	Import Stand Alone Debt Schedule	
Energy Audit Survey	Energy Audit Survey	

Understanding the Navigation Menu

The model tries to keep track of your interactions via the navigation menu that is found on every tab in the model.

- To start, click on the navigation menu 
- A new interaction screen is opened that gives you an option to select the technology of choice i.e., SHS or mini-grid
- It also provides the option to return to the start page or exit



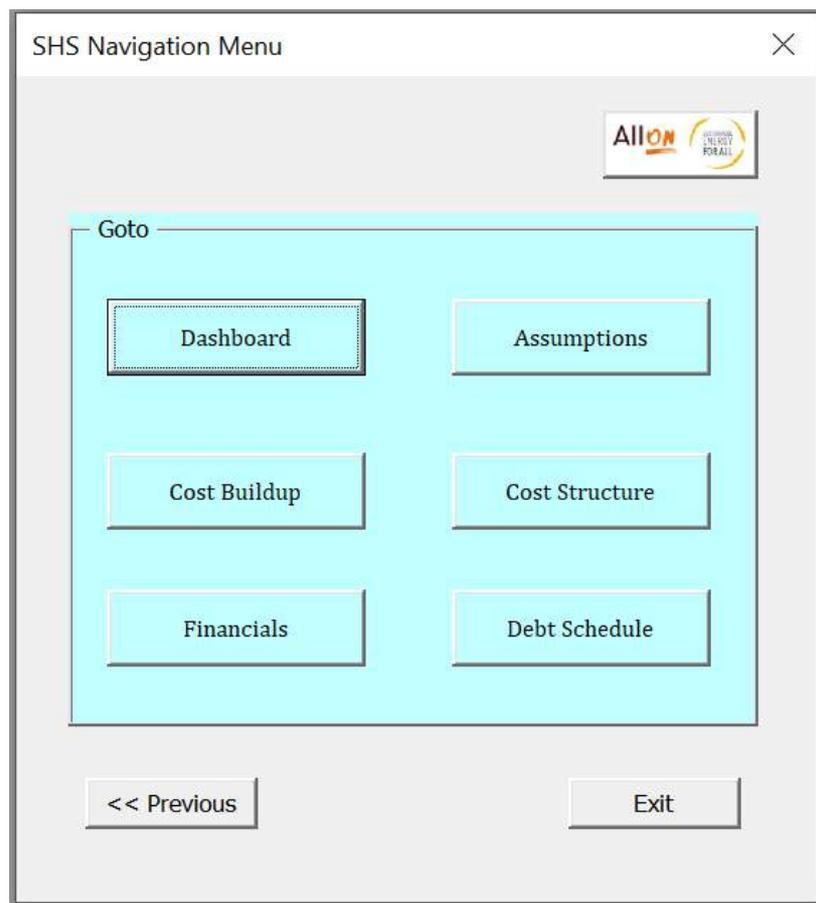
Navigating the Solar Home System Menu

- To start, click on the solar home system (SHS) button
- A new interaction screen is displayed with options to navigate the tabs that are associated with the building of the SHS model
- There are also options to return to the previous page and exit

Navigating the Solar Home System Menu

Continued

- The SHS navigation menu as seen below allows the user to go to the SHS dashboard, SHS specific model assumptions, buildup of all associated costs and cost structure, the three financial statements and the debt schedule
- For this user guide, the focus will be on the dashboard



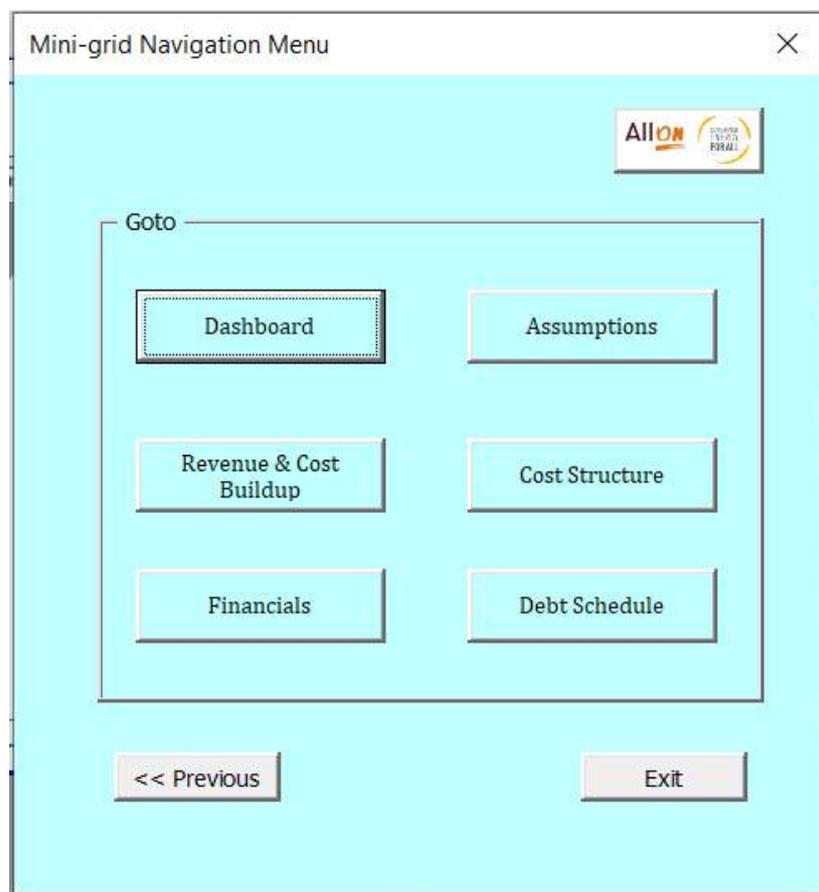
Navigating the Mini-grid Menu

- To start, click on the mini-grid button
- A new interaction screen is displayed with options to navigate the tabs associated with the building of the mini-grid model in similar fashion to the SHS navigation menu

Navigating the Mini-grid Menu

Continued

- The mini-grid navigation menu as seen below allows the user to go to the mini-grid dashboard, mini-grid specific model assumptions, buildup of all associated costs and cost structure, the three financial statements and the debt schedule
- For this user guide, the focus will be on the dashboard



SHS and Mini-grid Dashboards

- The remainder of this manual will focus on the SHS and mini-grid dashboards
- All other tabs can be navigated and explored directly from the Excel version of the economic model

3

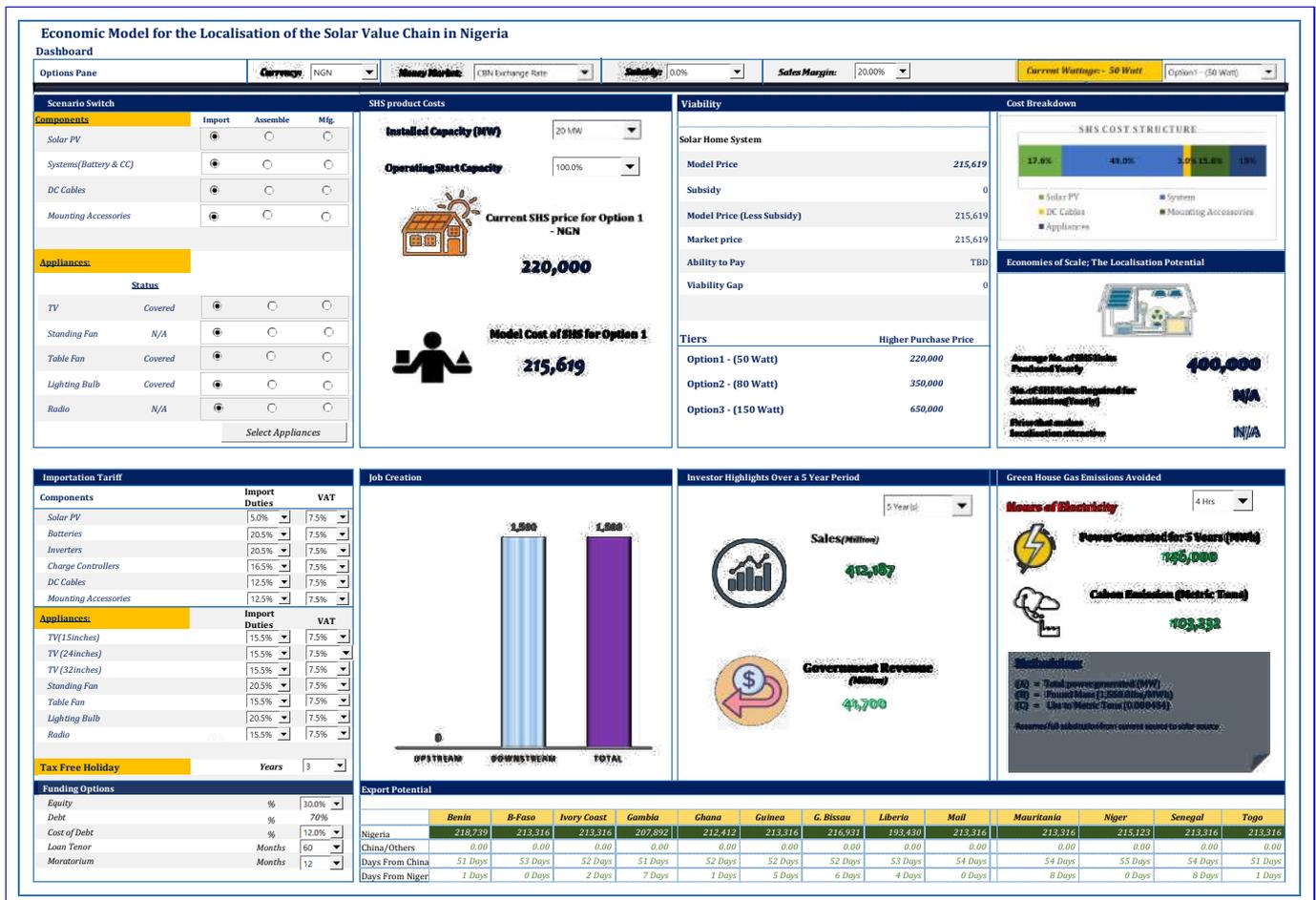
Navigating the SHS Dashboard



About the Solar Home System Dashboard

The SHS dashboard is a one-stop shop for the modelled market state scenarios, namely the importation of products (status quo), local assembly and local manufacturing.

The dashboard also provides insight into the impact of each of these scenarios on key economic indicators such as price, jobs created, GHG emissions saved etc. See below for a snapshot of the dashboard.



Left Side:
Scenarios and Options

Right Side:
Results based on Scenarios and Options

Main Sections of the SHS Dashboard

1. **The Options Pane:** This section allows the user to make changes to the model by exploring six key components: product currency, sources of foreign exchange, product subsidy, sales margin, product option and plant installed capacity.
2. **The Scenario Switch:** This section allows the user to make changes based on the three market state scenarios modelled: importation of SHS products, assembly and manufacturing of key components.
3. **Importation Tariff:** This section allows the user to make changes to port tariffs on their solar component of interest.
4. **Funding Options:** This section allows the user to make changes to the capital structure/funding options of the project.
5. **SHS Product Costs:** This section shows the resulting costs of an SHS based on changes made in 1–4 above.
6. **Subsidy Impact:** This section shows the resulting impact of an applied subsidy in option 1 on product price.
7. **Cost Breakdown:** This section shows the resulting SHS cost breakdown based on changes made in 1–4 above.
8. **Economies of Scale:** This section shows the number of product units required to make localization attractive once the user decides to select an assembly option in 2 above.
9. **Job Creation:** This section shows the potential number of jobs created based on changes made in 1 above.
10. **Financial Highlights:** This section shows the impact of 1–4 above on private and public (government) revenues.
11. **GHG Emissions Avoided:** This section shows the number of GHG emissions avoided based on changes made to 1–4 above.
12. **Export Potential:** This section shows Nigeria's export potential by comparing product prices and delivery time when products are procured from Nigeria as compared to China.

Exploring the Options Pane

The screenshot shows the 'Options Pane' interface with the following settings:

- Currency: NGN
- Money Market: CBN Exchange Rate
- Subsidy: 0.0%
- Sales Margin: 20.00%
- Current Wattage: 50 Watt
- Option: 50 Watt
- Installed Capacity (MW): 20 MW
- Operating Start Capacity: 100.0%

The Options Pane:

- **Currency:** Users can change the model currency between NGN and USD
- **Money Market:** Users can change the USD/NGN exchange rate between the Central Bank of Nigeria's rate and the parallel unofficial market rate
- **Subsidy:** Users can choose between several subsidy rates on the price of the SHS product
- **Sales Margin:** Users can apply different sales margins on the cost of an SHS
- **SHS Option:** Users can select between the three Tier 2 SHS options modelled: 50W, 80W and 150W
- **Plant Installed Capacity:** Users can select a range of installed capacity for their desired assembly and manufacturing plants. For fully imported SHS units, the installed capacity is a unit driver i.e., a 10MW plant will mean importation of 200,000/50Wp systems.

Exploring the Scenario Switch Buttons

Scenario Switch				
Components		Import	Assemble	Mfg.
Solar PV		<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Systems(Battery & CC)		<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
DC Cables		<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Mounting Accessories		<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Appliances:				
	<u>Status</u>			
TV	Covered	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Standing Fan	N/A	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Table Fan	Covered	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Lighting Bulb	Covered	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Radio	N/A	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="button" value="Select Appliances"/>				

The Scenario Switches:

- The scenario switches allow the user to select the three distinct scenario types namely: i) importation of SHS products ii) assembly of SHS products and iii) manufacturing of SHS products. These scenarios are then applied to either SHS components or appliances as seen above.
- Selection of any of these scenario Switch buttons will have an effect on the price of SHS products.
- For example, the screenshot above currently shows that all SHS products and appliances are imported. Clicking on any of the switch buttons will change this dynamic. This is seen below in the screenshot showing solar PV assembly in Nigeria.

Scenario Switch				
Components		Import	Assemble	Mfg.
Solar PV		<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
Systems(Battery & CC)		<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
DC Cables		<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Mounting Accessories		<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>

Exploring the Scenario Switch Buttons

Continued

Appliances:

	<u>Status</u>	
TV	Covered	<input checked="" type="radio"/> <input type="radio"/> <input type="radio"/>
Standing Fan	N/A	<input checked="" type="radio"/> <input type="radio"/> <input type="radio"/>
Table Fan	Covered	<input checked="" type="radio"/> <input type="radio"/> <input type="radio"/>
Lighting Bulb	Covered	<input checked="" type="radio"/> <input type="radio"/> <input type="radio"/>
Radio	N/A	<input checked="" type="radio"/> <input type="radio"/> <input type="radio"/>

Select Appliances 

Selecting Appliances:

- The model allows the user to freely select a combination of desired appliances to go with the SHS components
- Clicking on the select appliances button will display a new dialogue prompting users to select desired appliances with their individual ratings as seen below

Appliances Combination Menu ×



50 Watt

Appliance 1: TV (15) - (20 Watt) ▼

Appliance 2: LED Light - (5 Watt) ▼

Appliance 3: LED Light - (5 Watt) ▼

Appliance 4: Table Fan - (15 Watt) ▼

Appliance 5: LED Light - (5 Watt) ▼

Appliance 6: 0 ▼

150 Watt

Appliance 1: LED Light - (5 Watt) ▼

Appliance 2: LED Light - (5 Watt) ▼

Appliance 3: TV (32) - (70 Watt) ▼

Appliance 4: Standing Fan - (25 We) ▼

Appliance 5: LED Light - (5 Watt) ▼

Appliance 6: LED Light - (5 Watt) ▼

Appliance 7: Radio - (10 Watt) ▼

Appliance 8: LED Light - (5 Watt) ▼

Appliance 9: TV (32) - (70 Watt) ▼

Appliance 10: TV (32) - (70 Watt) ▼

80 Watt

Appliance 1: LED Light - (5 Watt) ▼

Appliance 2: LED Light - (5 Watt) ▼

Appliance 3: TV (24) - (48 Watt) ▼

Appliance 4: LED Light - (5 Watt) ▼

Appliance 5: Radio - (10 Watt) ▼

Appliance 6: LED Light - (5 Watt) ▼

Appliance 7: 0 ▼

Appliance 8: 0 ▼

Update Appliance

Exit

Exploring the Scenario Switch Buttons

Continued

Selecting Appliances, continued:

- Once the desired selection is complete and depending on the SHS option, users must click the updated appliance button for selection changes to be affected
- Once updated, the appliances section of the dashboard will show what appliances are covered in the user selection status
- The screenshot below indicates the user has selected a TV, lighting bulb and table fan as the preferred appliances for the SHS
- All of these have implications on the pricing of the product



The screenshot shows a table titled 'Appliances' with a yellow header. The table has five rows and three columns. The first column lists appliance types, the second column shows their status, and the third column contains three radio buttons. A red rectangular box highlights the 'Status' column. The status for 'TV', 'Table Fan', and 'Lighting Bulb' is 'Covered', while 'Standing Fan' and 'Radio' are 'N/A'. The radio buttons for 'TV', 'Table Fan', and 'Lighting Bulb' are checked, indicating they are selected.

Appliances:	Status			
TV	Covered	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Standing Fan	N/A	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Table Fan	Covered	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Lighting Bulb	Covered	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Radio	N/A	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>

Exploring the Importation Tariff

Importation Tariff		
Components	Import Duties	VAT
<i>Solar PV</i>	5.0% ▾	7.5% ▾
<i>Batteries</i>	20.5% ▾	7.5% ▾
<i>Inverters</i>	20.5% ▾	7.5% ▾
<i>Charge Controllers</i>	16.5% ▾	7.5% ▾
<i>DC Cables</i>	12.5% ▾	7.5% ▾
<i>Mounting Accessories</i>	12.5% ▾	7.5% ▾
Appliances:	Import Duties	VAT
<i>TV(15inches)</i>	15.5% ▾	7.5% ▾
<i>TV (24inches)</i>	15.5% ▾	7.5% ▾
<i>TV (32inches)</i>	15.5% ▾	7.5% ▾
<i>Standing Fan</i>	20.5% ▾	7.5% ▾
<i>Table Fan</i>	15.5% ▾	7.5% ▾
<i>Lighting Bulb</i>	20.5% ▾	7.5% ▾
<i>Radio</i>	15.5% ▾	7.5% ▾
	20%	
Tax Free Holiday	Years	1 ▾

Importation Tariff:

- This section of the model allows the user to make a varied selection of importation tariffs on solar components and appliances
- The tax-free holiday option mirrors the pioneer status incentive of the FGN
- Both segments have an impact on product price for both the SHS distributor/assembler as well as the manufacturer's profit

Exploring the Funding Options

Funding Options		
<i>Equity</i>	%	30.0% ▼
<i>Debt</i>	%	70%
<i>Cost of Debt</i>	%	12.0% ▼
<i>Loan Tenor</i>	<i>Months</i>	60 ▼
<i>Moratorium</i>	<i>Months</i>	12 ▼

Funding Options:

- This section of the model allows the user to change the capital structure of their funding and vary the cost of debt to see the impact on the price of the product and profitability

Interpreting the SHS Product Costs Section

SHS product Costs

Installed Capacity (MW)

Operating Start Capacity

 **Current SHS price for Option 1
- NGN**

220,000

 **Model Cost of SHS for Option 1**

215,619

SHS Product Costs:

- This section of the model is result driven and only concerns itself with output from the other sections already described above
- It compares the current market price of the product against the modelled cost/price of the product
- Users can quickly see the deviation of the modelled price against the market price

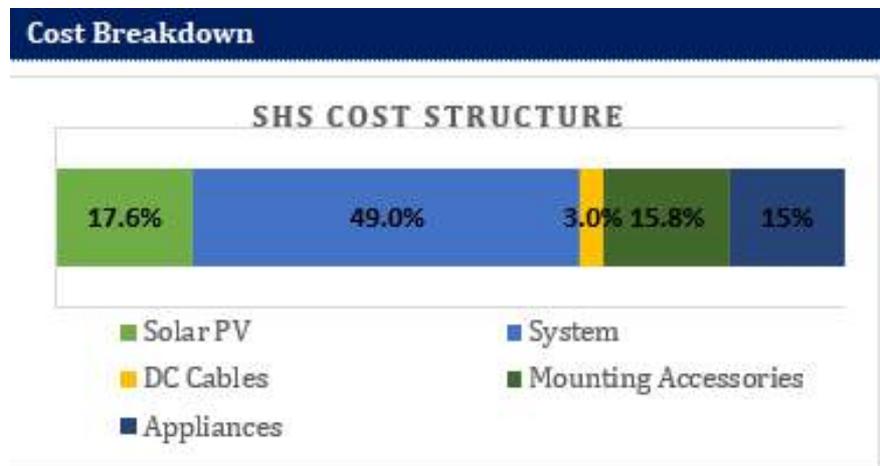
Subsidy Impact

Subsidy Impact	
Solar Home System	
Model Price	215,619
Subsidy	0
Model Price (Less Subsidy)	215,619
Market price	215,619
Ability to Pay	TBD
Viability Gap	0

Subsidy Impact:

- This section shows the impact of product subsidy on the modelled price of the product

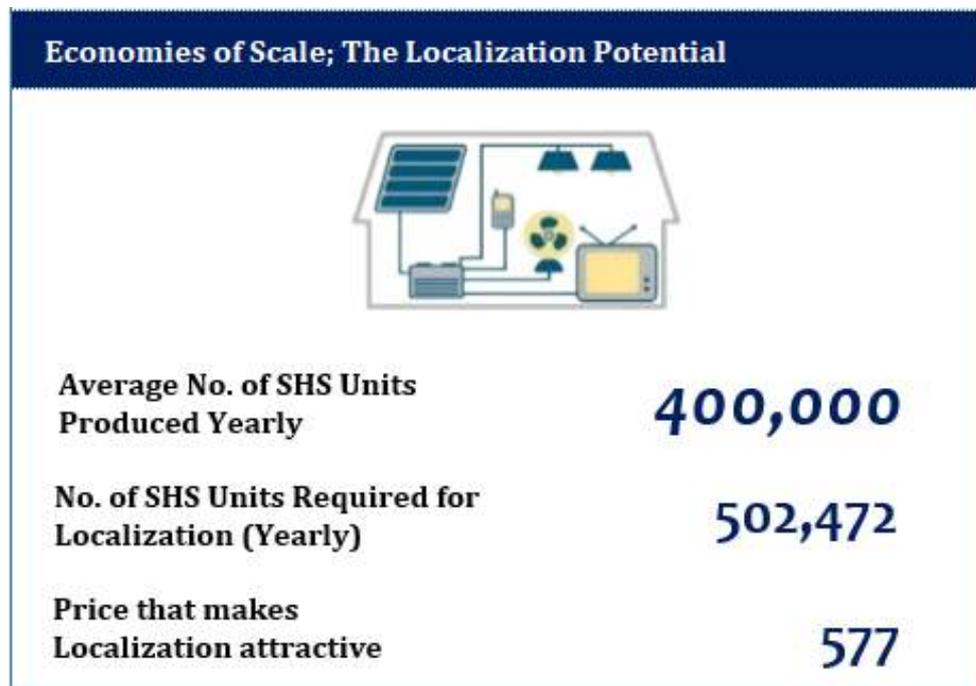
Cost Breakdown



Cost Breakdown:

- This shows the resulting SHS cost breakdown based on the various scenario changes described in earlier chapters

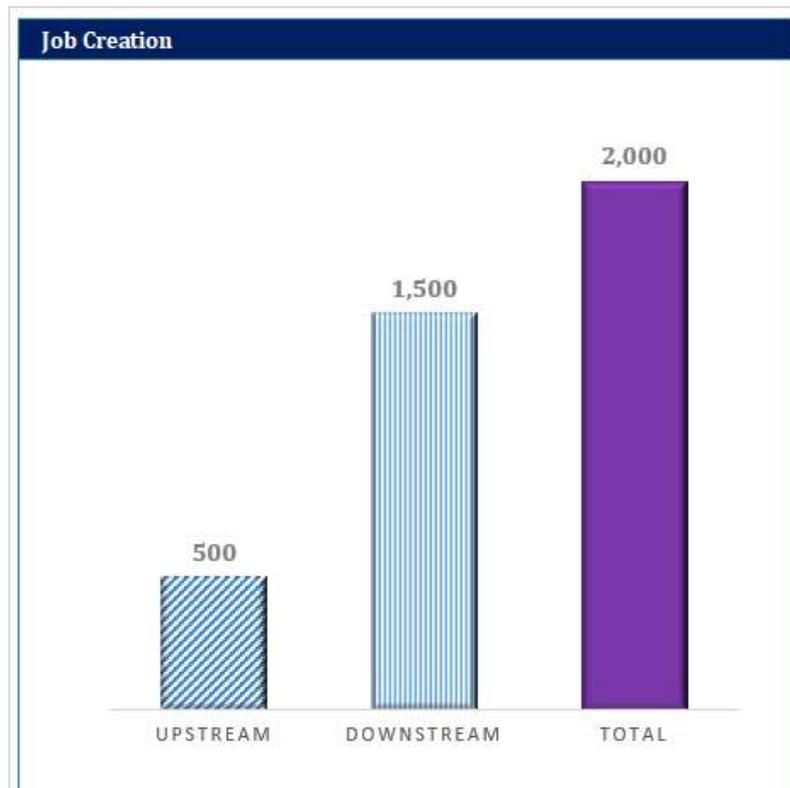
Economies of Scale



Economies of Scale:

- This section presents the number of product units required to make localization attractive once the user decides to select an assembly or manufacturing option

Job Creation



Job Creation:

- This shows the resulting number of jobs created from increasing capacity

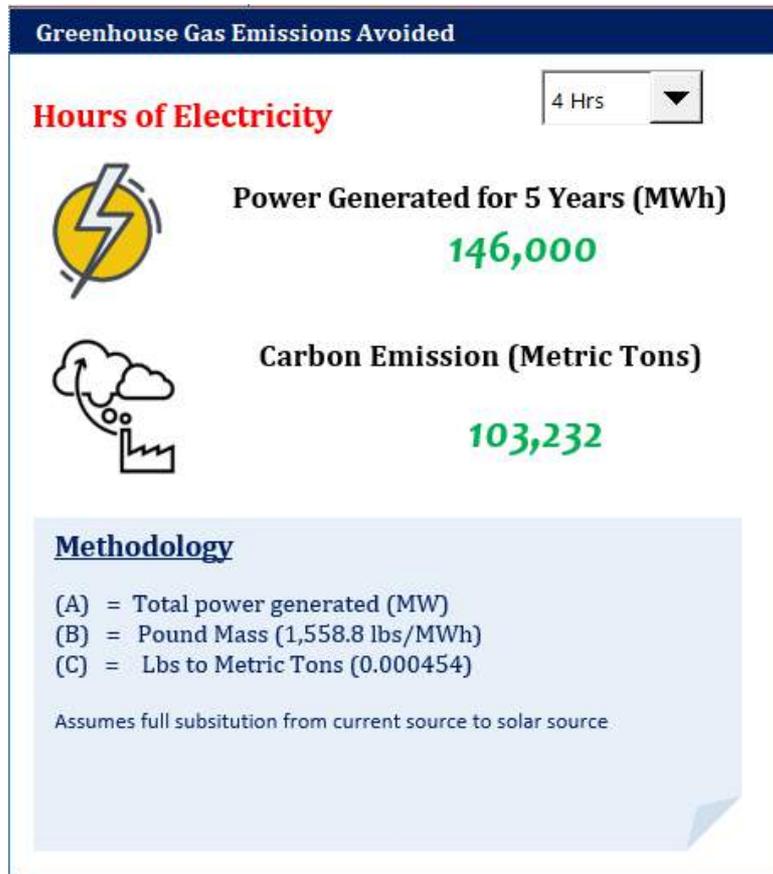
Financial Highlights



Financial Highlights:

- This shows the resulting private sector and government revenues based on user-selected scenarios

Greenhouse Gas Emissions Avoided



GHG Emissions Avoided:

- This shows the resulting GHG emissions avoided based on the assumption that the selected solar option is a full substitute for previous alternative power sources
- This section allows the user to vary the number of electricity hours provided on a daily basis

Export Potential

Export Potential							
	<i>Benin</i>	<i>B-Faso</i>	<i>Ivory Coast</i>	<i>Gambia</i>	<i>Ghana</i>	<i>Guinea</i>	<i>G. Bissau</i>
Nigeria	218,739	213,316	213,316	207,892	212,412	213,316	216,931
China/Others	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Days From China	51 Days	53 Days	52 Days	51 Days	52 Days	52 Days	52 Days
Days From Nigeria	1 Days	0 Days	2 Days	7 Days	1 Days	5 Days	6 Days

Export Potential:

- This section tries to provide a comparative analysis of the impact of a solar-enabled Nigeria across the ECOWAS region
- It compares the price of the selected SHS between a Nigerian assembled (and exported regionally) SHS to an SHS imported from China in the row immediately after
- It also shows the supply chain (days at sea) differences between importing products from Nigeria and from China (a proxy for the biggest importer)

4

Navigating the Mini-grid Dashboard



About the Mini-grid Dashboard

The mini-grid dashboard is a one-stop shop for the modelled scenarios (importation of products (status quo), local assembly and local manufacturing) and the impact of each of these scenarios on key economic indicators such as the mini-grid tariff, jobs created, GHG Emissions saved etc. This is shown below.

Economic Model for the Localisation of the Solar Value Chain in Nigeria
Minigrd - Dashboard

Options Pane Currency: NGN Money Market: Parallel Market Sales Margin: 20.00%

Scenario Switch			
Components	Import	Assemble	Mfg.
Solar PV	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Batteries	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Inverters	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Charge Controllers	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
DC Cables	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Mounting Accessories	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>

Minigrd Tariff

Number of Connections: 500,000

Cost Recovery Tariff (kWh) - NGN: **389.98**

Power Generated for 10 Years (MWh): **179,087**

Viability

Minigrd	
Model Tariff	389.98
Market price	250.00
Ability to Pay	
Viability Gap	-139.98

Cost Breakdown

MINIGRID COST STRUCTURE

Legend: Solar PV, Batteries, Inverter, Charge Controller, DC Cables, Mounting Accessories

Importation Tariff		
Components	Import Duties	VAT
Solar PV	5.0%	7.5%
Batteries	20.5%	7.5%
Inverters	15.5%	7.5%
Charge Controllers	16.5%	7.5%
DC Cables	12.5%	7.5%
Mounting Accessories	12.5%	7.5%

Funding Options

Equity	%	30.00%
Debt	%	70%
Cost of Debt	%	12.0%
Loan Tenor	Months	60
Moratorium	Months	12

Tax Free Holiday: Years: 3

Job Creation

Financial Highlights Over a 10 Years Period

Revenue (Million): **46,350**

Government Revenue (Million): **3,758**

Green House Gas Emissions Avoided

Hours of Electricity: 4 Hrs

Power Generated for 10 Years (MWh): **179,087**

Carbon Emission (Metric Tons): **126,627**

Methodology

(A) = Total power generated (MW)
 (B) = Pound Mass (1,558.8 lbs/MWh)
 (C) = Lbs to Metric Tons (0.000454)

Assumes full substitution from current source to solar source

Left Side:
Scenarios and Options

Right Side:
Results based on Scenarios and Options

Main Sections of the Mini-grid Dashboard

1. **The Options Pane:** This section allows the user to make changes to the model by exploring four key components – namely product currency, sources of forex, sales margin and number of connections.
2. **The Scenario Switch:** This section allows the user to make changes based on the three main scenarios modelled, importation, assembly and manufacturing.
3. **Importation Tariff:** This section allows the user to make changes to port tariffs on the modelled solar components.
4. **Funding Options:** This section allows the user to make changes to capital structure/funding options.
5. **Mini-grid Tariff:** This section shows the resulting costs of an SHS based on changes made in 1–4 above.
6. **Viability:** This section tries to compare the modelled tariff to current market tariffs.
7. **Cost Breakdown:** This section shows the resulting mini-grid cost breakdown based on changes made in 1–4 above.
8. **Job Creation:** This section shows the potential number of jobs created based on changes made in 1 above.
9. **Financial Highlights:** This section shows the impact of 1–4 above on private and public (government) revenues.
10. **GHG Emissions Avoided:** This section shows the number of GHG emissions avoided based on changes made to 1–4 above.

Exploring the Options Pane

Options Pane	Currency: NGN ▼	Money Market: Parallel Market ▼	Sales Margin: 20.00% ▼
Number of Connections			500,000 ▼

The Options Pane:

- Currency: Users can change the model currency between NGN and USD
- Money Market: Users can change the USD/NGN exchange rate between the Central Bank of Nigeria's rate and the parallel unofficial market rate
- Sales Margin: Users can apply different sales margins on the cost of SHS
- Number of Connections: Users can change the number of connections as desired

Exploring the Scenario Switch Buttons

Scenario Switch			
Components	Import	Assemble	Mfg.
<i>Solar PV</i>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
<i>Batteries</i>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
<i>Inverters</i>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
<i>Charge Controllers</i>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
<i>DC Cables</i>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
<i>Mounting Accessories</i>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>

The Scenario Switches:

- The scenario switches allow the user to select the three distinct scenario types namely i) importation of mini-grid component products ii) assembly of component products and iii) manufacturing of component products.
- Selection of any of these scenario switch buttons will have an effect on the mini-grid tariff.
- For example, the screenshot above currently shows all mini-grid components are imported. Clicking on any of the switch buttons will change this dynamic. This is seen below in the screenshot showing solar PV assembly in Nigeria.

Scenario Switch			
Components	Import	Assemble	Mfg.
<i>Solar PV</i>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
<i>Batteries</i>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
<i>Inverters</i>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
<i>Charge Controllers</i>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
<i>DC Cables</i>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
<i>Mounting Accessories</i>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>

Exploring the Importation Tariff

Importation Tariff		
Components	Import Duties	VAT
<i>Solar PV</i>	5.0% ▼	7.5% ▼
<i>Batteries</i>	20.5% ▼	7.5% ▼
<i>Inverters</i>	15.5% ▼	7.5% ▼
<i>Charge Controllers</i>	16.5% ▼	7.5% ▼
<i>DC Cables</i>	12.5% ▼	7.5% ▼
<i>Mounting Accessories</i>	12.5% ▼	7.5% ▼
Tax Free Holiday	<i>Years</i>	3 ▼

Importation Tariff:

- This section of the model allows the user to make a varied selection of importation tariffs on solar components
- The tax-free holiday option mirrors the pioneer status incentive of the FGN
- Both segments have an impact on the mini-grid tariff

Exploring the Funding Options

Funding Options		
<i>Equity</i>	%	30.00% ▼
<i>Debt</i>	%	70%
<i>Cost of Debt</i>	%	12.0% ▼
<i>Loan Tenor</i>	Months	60 ▼
<i>Moratorium</i>	Months	12 ▼

Funding Options:

- This section of the model allows the user to change the capital structure of the funding and vary the cost of debt to see the impact on the price of the product and profitability

Interpreting the Mini-grid Tariff Section

Mini-grid Tariff

Number of Connections

 **Cost Recovery Tariff (kWh) - NGN**
204.27

 **Power Generated for 10 Years (MWh)**
179,087

Mini-grid Tariff:

- This section of the model is result driven and only concerns itself with the outputs of sections already described above
- It displays the cost recovery tariff for the mini-grid installation based on the scenarios previously described and the number of mini-grid connections (i.e., customers)
- Users can quickly make a comparison between the modelled tariff and current market tariffs

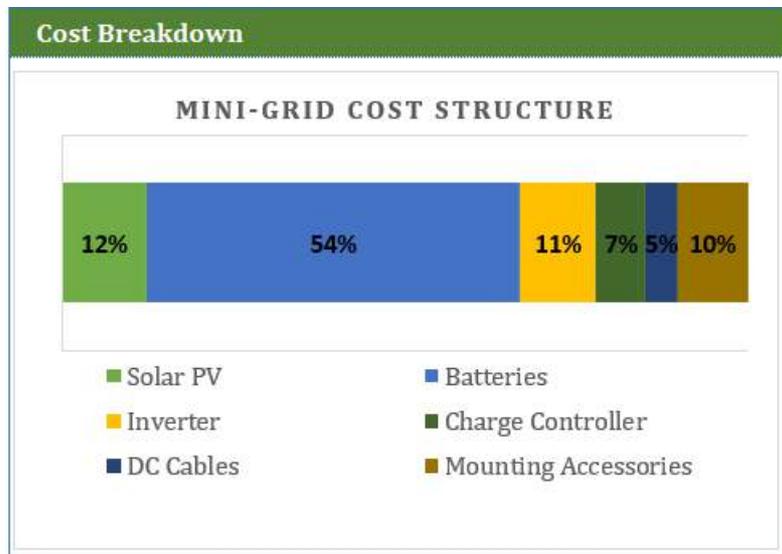
Viability

Viability	
<u>Mini-grid</u>	
Model Tariff (kWh)	204.27
Market price	250.00
Ability to Pay	
Viability Gap	0.00

Viability:

- This shows the gap between modelled price and average current market tariff

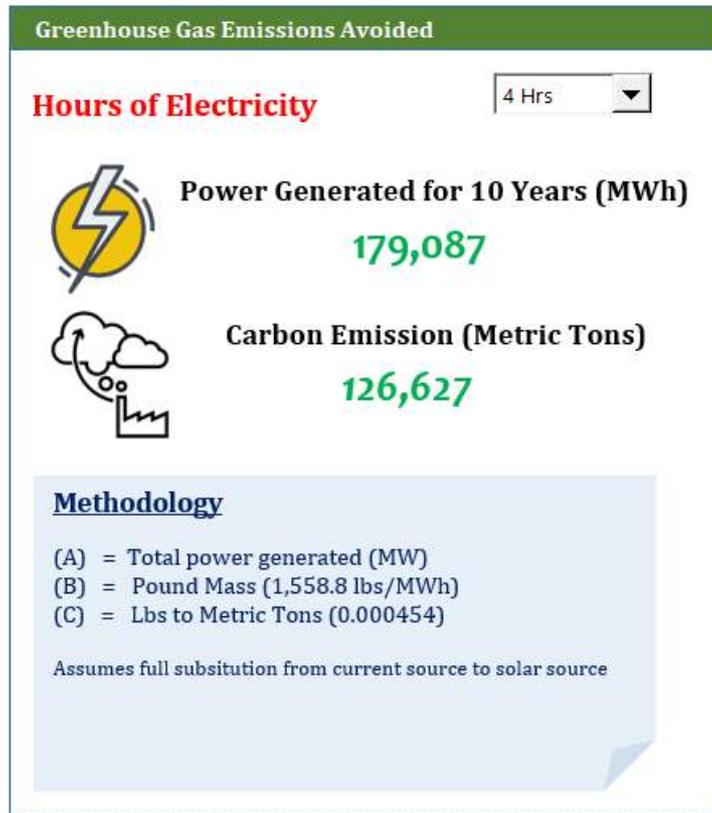
Cost Breakdown



Cost Breakdown:

- This shows the resulting cost breakdown of mini-grid components based on the various scenario changes described in earlier chapters

Greenhouse Gas Emissions Avoided



GHG Emissions Avoided:

- This section shows the resulting GHG emissions avoided based on the assumption that the solar mini-grid option is a full substitute for previous alternative power sources
- This section also allows the user to vary the number of electricity hours provided on a daily basis

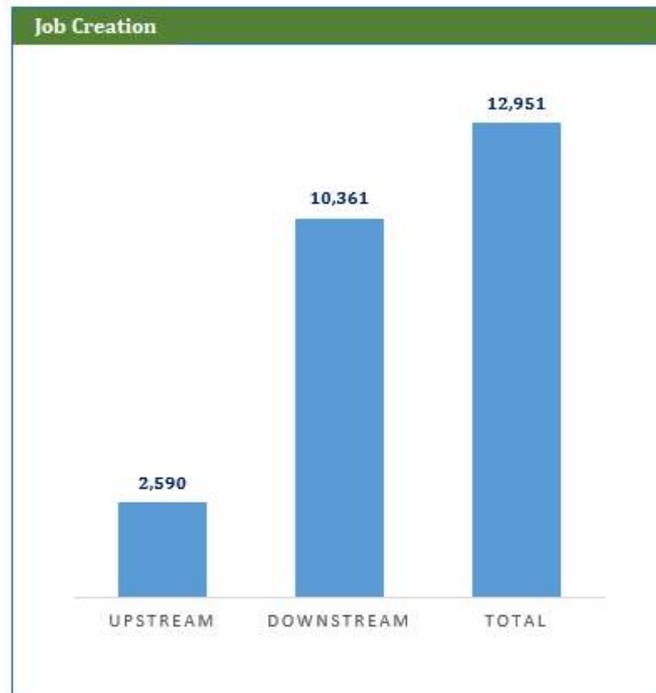
Financial Highlights



Financial Highlights:

- This section shows the resulting private sector and government revenues based on user-selected scenarios

Job Creation



Job Creation:

- This section shows the resulting number of jobs created from increasing capacity

5

Working with the Main Input Sheet



About the Main Input Sheet

The main input sheet is the primary source for the model's assumptions; it is a display of the base data used to calculate the model scenarios and their resulting output. To better understand the main input sheet assumptions, it serves to understand how the costs for an SHS product and mini-grid tariff are derived.

Solar Home Systems Cost Derivation

The model is predominantly driven by a cost-per-watt methodology where costs are aggregated from a per-watt level to a per-unit level for components, appliances and all other ancillary cost items.

Details of how these costs are aggregated for the three modelled scenarios (importation, assembly and manufacturing) and product type (e.g., solar PV) are outlined below:

S/N	Calculation Steps	Importation	Assembly	Manufacturing
1	Sourced cost of component raw materials or component per watt	✓	✓	✓
2	Derived cost of all import tariffs per watt	✓	✓	✓
3	Derived cost of insurance per watt	✓	✓	✓
4	Derived cost of VAT per watt	✓	✓	✓
5	Summation of (1) – (4) above to arrive at landed cost per watt	✓	✓	✓
6	Multiplied landed cost per watt by desired system size to arrive at cost per unit	✓	✓	✓
7	Derived capex recovery cost per unit	✗	✓	✓
8	Derived opex recovery cost per unit	✓	✓	✓
9	Derived debt recovery cost per unit	✓	✓	✓
10	Summation of (6) – (9) above was used to arrive at the implied SHS cost	✓	✓	✓

Cost Breakdown

The mini-grid cost tariff is a bottom-up approach where the cost of development, power generation, power distribution, metering and other ancillary costs are derived and divided by the total quantum of power to be generated during the modelled useful life of the asset.

S/N	Calculation Steps
1	Derived the cost of site, site preparation and lease (generation)
2	Derived the cost design, feasibility and engineering
3	Derived the cost of construction and installation
4	Derived the cost of testing and commissioning
5	Derived the cost of generation assets with varying costs as mirrored from the SHS process i.e., asset could be imported, assembled or manufactured locally
6	Derived the cost of distribution assets
7	Derived the cost of metering costs
8	Derived other ancillary costs i.e., insurance and contingencies
9	Summation of (1) – (9) above to arrive at total capex costs
10	Less NEP Capex Subsidy of \$350/connection to arrive at the subsidized capex costs
11	Derived operating expenses and interest expenses
12	Summation of (11) and (12) to arrive at full costs of generation for the mini-grid
13	Derived the quantum of power generated over the desired period
14	Division of (13) by (12) to arrive at cost recovery tariff for the mini-grid

Model Assumptions

The model assumptions are divided into various sub-components. This handbook will focus on a few key assumptions while the remainder not described here are detailed in the model's main input sheet tab.

Macro Assumptions:

- VAT – 7.5%
- Company income tax – 32%
- Pension contribution – 18%
- Industrial training funds – 1%
- Nigeria Social Insurance Trust Fund – 1%
- CBN exchange rate - \$1/N381
- Parallel market rate - \$1/N468

Import Tariff Assumptions on Components and Appliances:

Component	Import Tariff	Appliance	Import Tariff
Solar PV	5.0%	TV (32)	15.5%
Batteries	20.5%	Standing Fan	20.5%
Inverters	20.5%	Table Fan	15.5%
Charge Controllers	16.5%	LED Light	20.5%
DC Cables	12.5%	Radio	15.5%
Mounting Accessories	12.5%		

Economies of Scale:

- Imported SHS products have a discount table as seen below for applicable reduction in price based on additional volume of units purchased

Unit (From)	Unit (To)	% Discount
0	199,999	0%
200,000	999,999	5%
1,000,000	Above	10%

- Assembly and manufacturing plants gain cost efficiency on products to the tune of 0.04% per MW of production

Jobs Created Assumptions:

- For every 1MW of capacity added:
 - 75 downstream jobs are created
 - 25 upstream jobs are created for an assembler
 - 13 upstream jobs are created for the manufacturer

Financing Assumptions:

- 70% debt and 30% equity
- 5 Year loan tenor with 1 Year moratorium
- WACC: 22%
- Cost of debt: 12%
- Cost of equity: 28%



All ON