Public Financial Management Reform Project (PFMRP)-Establishment of the Unit Cost of Infrastructure in Ghana

Unit Cost of Infrastructure Estimator and Budget Tool-Final User Guide

Ministry of Finance/Public Procurement Authority

September 2017

Ref No: PFRMP/PPA/comp 2.4/CS/08

Public Procurement Authority

Improving efficiency and transparency in Public Procurement

Table of Contents

List of Tables

List of Figures

List of Abbreviations

Abbreviation	Meaning
AAC	Asphalt, Cement, Concrete
AESL	Architectural & Engineering Services Limited
AR	Ashanti Region
BAR	Brong Ahafo Region
CCB	COCOBOD
CF	Consolidated Fund
CR	Central Region
DFR	Department of Feeder Roads
DSD	Double Surface Dressing
DUR	Department of Urban Roads
ECG	Electricity Company of Ghana
ER	Eastern Region
GAR	Greater Accra Region
GHA	Ghana Highway Authority
GHS	Ghana Cedi
GOG	Government Of Ghana
GRAV	Gravelling
GRIDCo	Ghana Grid Company
HA	Heavy Angle
IP	Intermediate Pole
kV	Kilovolt
LA	Light Angle
LV	Low Voltage
MMDAs	Metropolitan, Municipal and District Assemblies
MoF	Ministry of Finance
MRH	Ministry of Roads and Highways
MVA	Mega Volt Ampere
NEDCo	Northern Electricity Distribution Company
NR	Northern Region
O&M	Operation and Maintenance
PCU	Project Coordination Unit
PFMRP	Management Reform Project
PPA	Public Procurement Authority
PPME	Public Procurement Model of Excellence
RF	Road Fund
RTU	Remote Terminal Unit
SP	Section Pole
SSD	Single Surface Dressing
TP	Terminal Pole
UER	Upper East Region
USD	United States Dollars
UWR	Upper West Region
VfM	Value for Money
VRA	Volta River Authority
VT	Voltage Transformer
WR	Western Region
XLPE	Cross-Linked Polyethylene

1. Background of the Project

1. Background of the Project

1.1. Background

[1]The ability to understand the level and components of investment required to support the development of infrastructure in developing countries is increasingly becoming very important for governments, donor agencies and financial institutions operating in these countries. These institutions need to know how much the investment in the infrastructure will cost and how those costs are determined in order to plan the financing and execution of these projects to achieve the best value for money.

Currently, the Public Procurement Authority (PPA) maintains a data base for common user items and therefore has reference prices for such items. However, PPA does not have a similar database for infrastructure, which accounts for a significant proportion of Ghana's national budget. The lack of reference prices leads to unrealistic budget estimates in the procurement plan for which many times the actual prices for delivering the infrastructure is are very different from the costs in the budget estimates.

Procurement reforms have progressed well over the years with the following notable achievements:

- Preparation of procurement tools including: draft procurement regulations, manuals (Procurement, Procurement Records Management, and Contract Management), Standard Bidding Documents, and various Policy Guidelines such as those on the application of Framework Agreements, Low and Minor Value Procurements;
- Putting in place the necessary systems for informing stakeholders about procurement in Ghana;
- Development and delivery of various training programs to public and private sector procurement practitioners and policy makers, including: contractors, suppliers and consultants;
- Development of a Public Procurement Model of Excellence (PPME) tool for measuring performance of procuring entities;
- Establishment of an Appeals and Complaints Panel for the successful administrative review;
- Introduction and implementation of the Sustainable Public Procurement concept;
- Publication and launch of the Scheme of Service for Procurement Class of the Civil/Local Government Service; and
- Preparation for the introduction of e-procurement.

Notwithstanding the above achievements, the procurement system in Ghana currently faces a number of challenges which are yet to be addressed. These challenges include, among others a lack of a reference price data base for infrastructure.

There is a common perception in Ghana that the cost of providing infrastructure is too high compared to other countries. However, there is no concrete data or system to prove this or otherwise, across the various types of infrastructure. The objective of this study is to provide a basis for comparative reference to facilitate cost benchmarking for these infrastructure projects.

[2]The need to establish the unit cost of infrastructure in Ghana has emerged due to the recurring problem of unrealistic budget estimates due to a lack of reference prices as well as actual prices of projects exceeding estimates. This causes huge strains on the Government's financial resources and hampers the development of the nation as a whole.

The cost of any infrastructure project varies based on technical requirements as well as the local circumstances such as the time of the year when the project is implemented, location, inflation, currency, foreign exchange costs etc. These factors tend to have a significant impact on the project costs and cause variations in the cost of delivery of infrastructure projects.

A database tool on the cost of the components of standard infrastructure projects is essential to support a benchmarking system which will ensure that the estimated total cost of the projects will deliver Value for Money (VfM) by reflecting realistic prices. This type of tool will allow the user to vary the elements identified

[1] Establishment of the Unit Cost of Infrastructure in Ghana - Project Terms of Reference
[2] Establishment of the Unit Cost of Infrastructure in Ghana - Project Terms of Reference

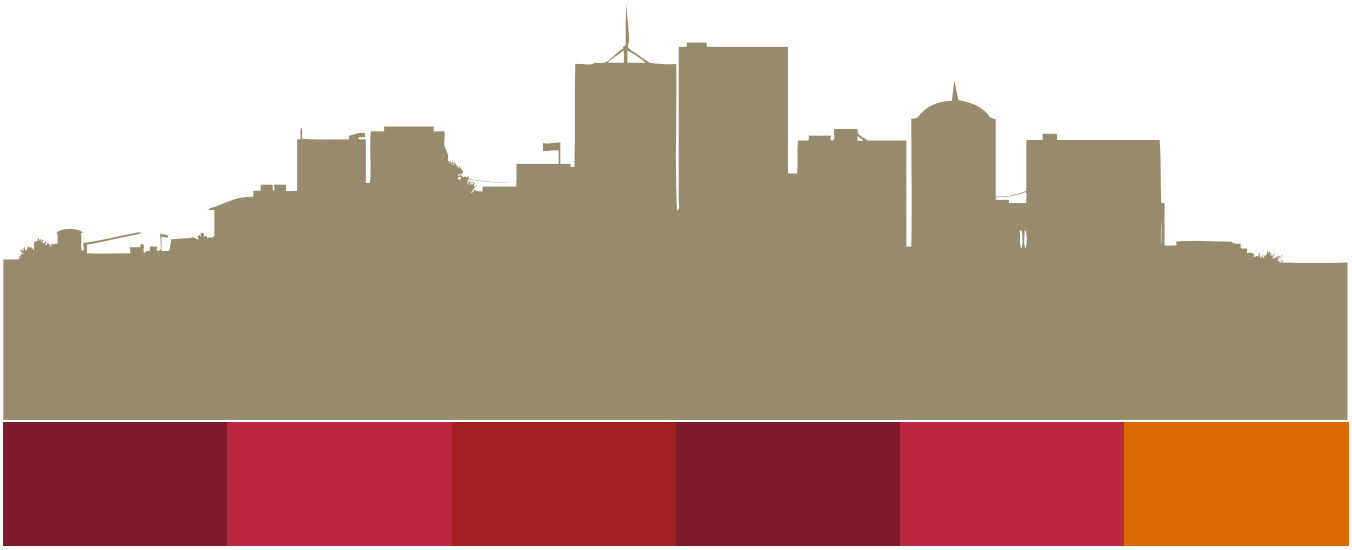
(major cost drivers) in order analyse how changing these factors affect the cost of delivering the project. This will help inform the decision making process of how much investment will be required, contingency arrangements and budgeting considerations. This can then help control unforeseen cost overruns, allow additional verification of key cost items and support any justifications for project cost items where necessary.

The Ministry of Finance (MoF) through financing from the World Bank is undertaking the Public Financial Management Reform Project (PFMRP) – Establishment of the Unit Cost of Infrastructure in Ghana ("the Project"), with the objective of creating a database tool to serve as a reference point for costing infrastructure development projects in Ghana whilst providing the benefits identified.

The sectors assessed as part of this study include:

- Roads;
- Buildings;
- Water and Sewerage systems; and
- Power (hydro, solar, wind, thermal, combined cycle plants, power barges, gas and other fuel plants).

This user guide was prepared to guide users on how to use the unit cost of infrastructure estimator and budget tool and also explain, to some extent, the basis of some of the assumptions applied in building the database.



2. The User Interface of the Unit Cost Estimator and Budget Tool

2. The User Interface of Home Page of the Unit Cost Estimator and Budget Tool

2.1. Home Page User Interface

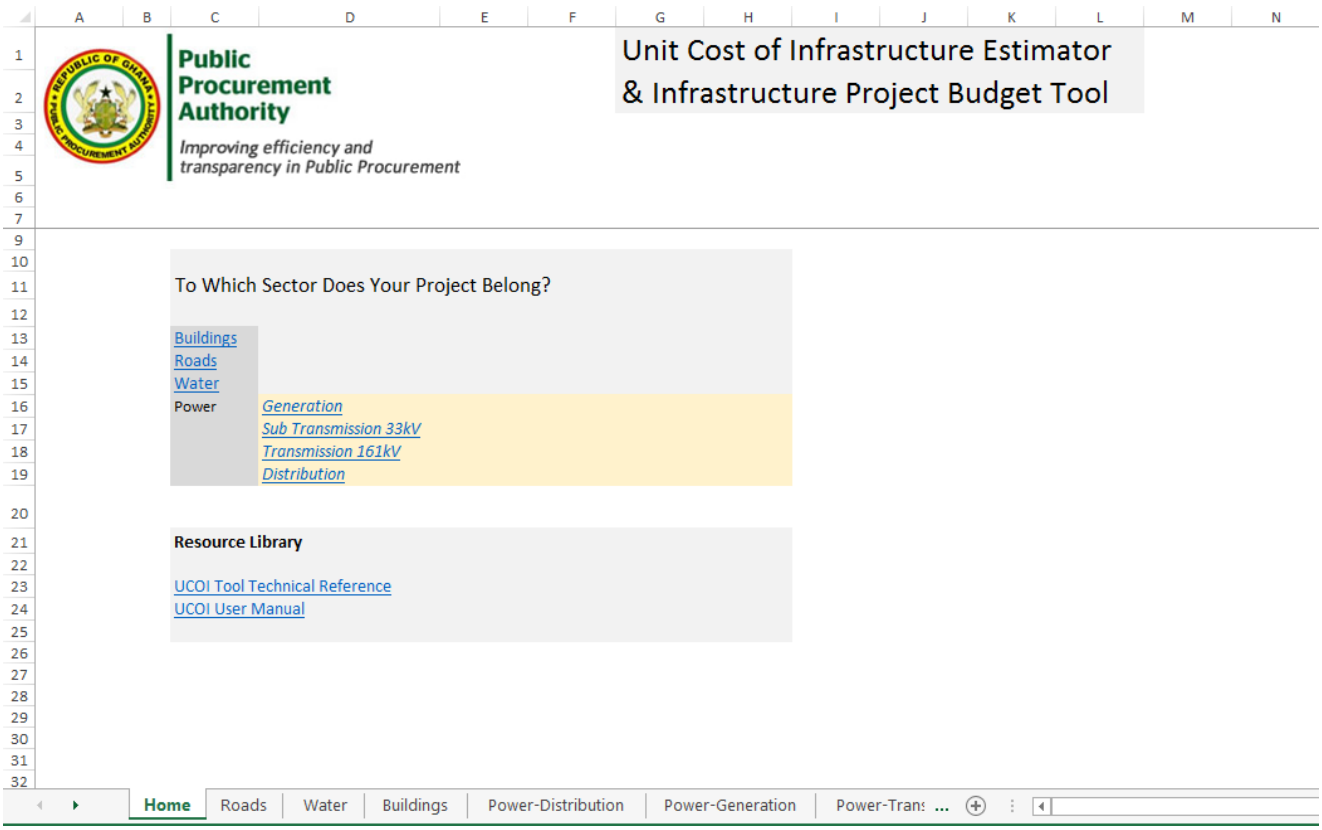
The entire unit cost estimator and budget tool resides in a Microsoft Excel spreadsheet. The landing page of the tool (see Figure 2-1 below) identifies the infrastructure sectors available as well as their sub-categories where applicable.

Each sector is name and sub-category can be clicked on to take the user to the selected sector or sub-category in order to view and interact with the unit cost estimator and budget tool for that sector.

Apart from Power, the main infrastructure sectors (Roads, Buildings and Water) on the home page are linked to their sheets and can be accessed by clicking on the names. The power sector has been split into Generation, Sub Transmission 33kV, Transmission 161kV and Distribution. The unit cost estimator and budget tool for each of these Power sub-categories can be accessed by clicking on their names on the home page.

Alternatively, the user can look through the spreadsheet tabs to select a sector or sector sub-category of interest to interact with the unit cost estimator and budget tool. Figure 2.1 shows screenshot of the home page and the linked sectors and sector sub categories. The linked sectors and sector sub categories are the only accessible aspects of the homepage.

Figure 2-1: User Interface of the Home Page



2.2. Sector and subsector User Interface

In the subsequent sections of this user guide, the user interface for the unit cost estimator and budget tool have been set out explained for each sector namely; roads, water, power and buildings. Each of these have been developed based on the nature of the data collected. Subject to the collection of more data, analysis of the additional data and review of the model build the interface may be updated to reflect the level of quantity and quality of data.

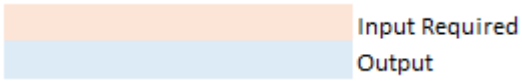
Where necessary, the individual sector sections also identify any noteworthy information that have informed the assumptions made by sector experts in developing the various components of the tool as well as any additional technical information necessary for users to apply in their interaction with the tool.

The following model approaches were applied:

- Road Sector: Data Segmentation;
- Building Sector: Data Segmentation;
- Power Sector: Component Cost; and
- Water Sector: Component Cost

An important aspect of the tool which must be noted by all users across the tool is summarised in the following key:

Figure 2-2: Input/ Output key



Cells in the interface with the colour labelled **'Input required'** imply that the user will have to enter a value in these cells in order to interact with the interface. Cells in the tool with the colour labelled **'Output'** are cells which produce an outcome based on selected input items in the tool.

3. Road Sector Unit Cost Estimator and Budget Tool

3. Road Sector Unit Cost Estimator and Budget Tool

3.1. User interface

3.1.1. Road Sector Unit Cost Estimator

The road sector unit cost estimator was developed with the data segmentation modelling approach. This approach was adopted because a moderately sized historical record of contracts with a reasonable number of cost drivers that reflect the nature of the road sector in Ghana was obtained.

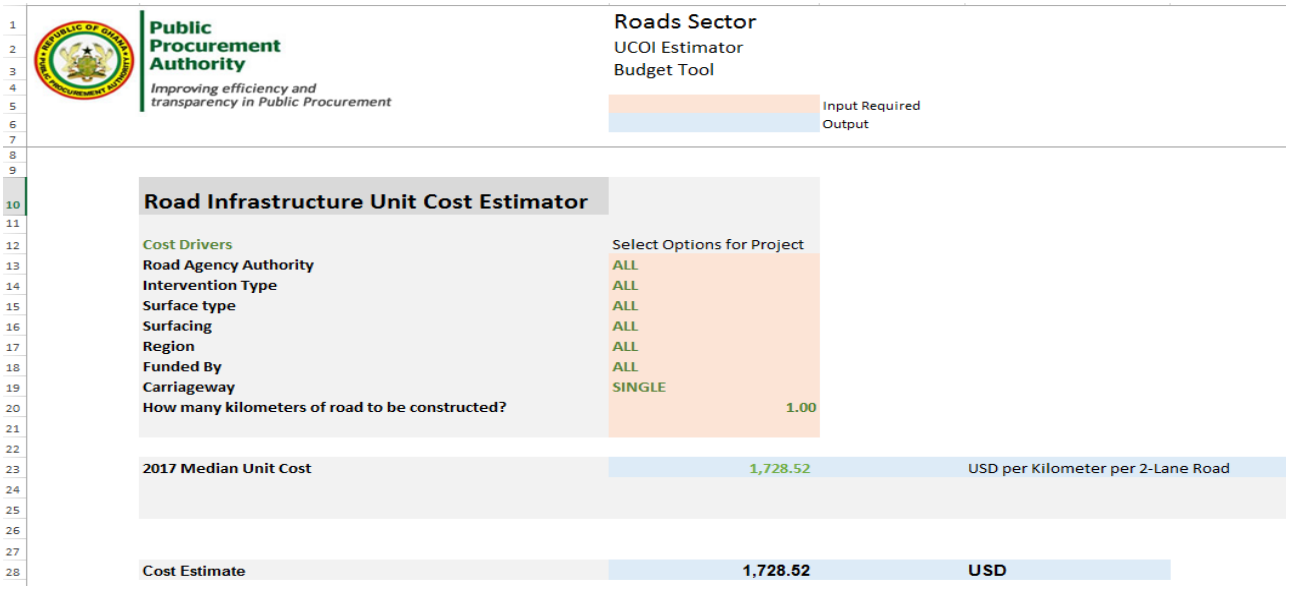
The historical road contract data was stratified into groups defined by the value of cost drivers and used the median historical inflation-adjusted project costs to estimate the unit cost of road infrastructure for a road project belonging to the identified segment.

The main cost drivers the analysis of the road sector identified included the following:

- The delivering Road Agency/Authority;
- The intervention type applied;
- The surface type used (paved or unpaved);
- The nature of the surfacing;
- Administrative region;
- Funding source;
- Carriageway type; and
- Number of kilometres of road to be constructed.

A screen shot of the user interface for the road sector unit cost estimator is shown below with the selectable cost drivers and the window where the unit cost output is presented after selecting the applicable drivers.

Figure 3-1: User Interface of the Road Sector Unit Cost Estimator



3.1.2. Road Sector Budget Tool

The road sector budget tool allows the user to include the cost of other factors that relate to the development of the road project. The budget tool under this project was developed based on the experience of road sector experts as well as based on interaction with the key stakeholders in the sector in Ghana.

The pre-set elements of the road sector project budget tool include budget allocation for:

- Feasibility studies/ Project Planning;
- Detailed Engineering Design (Consultancy Services); and
- Contract Administration (Construction Supervision).

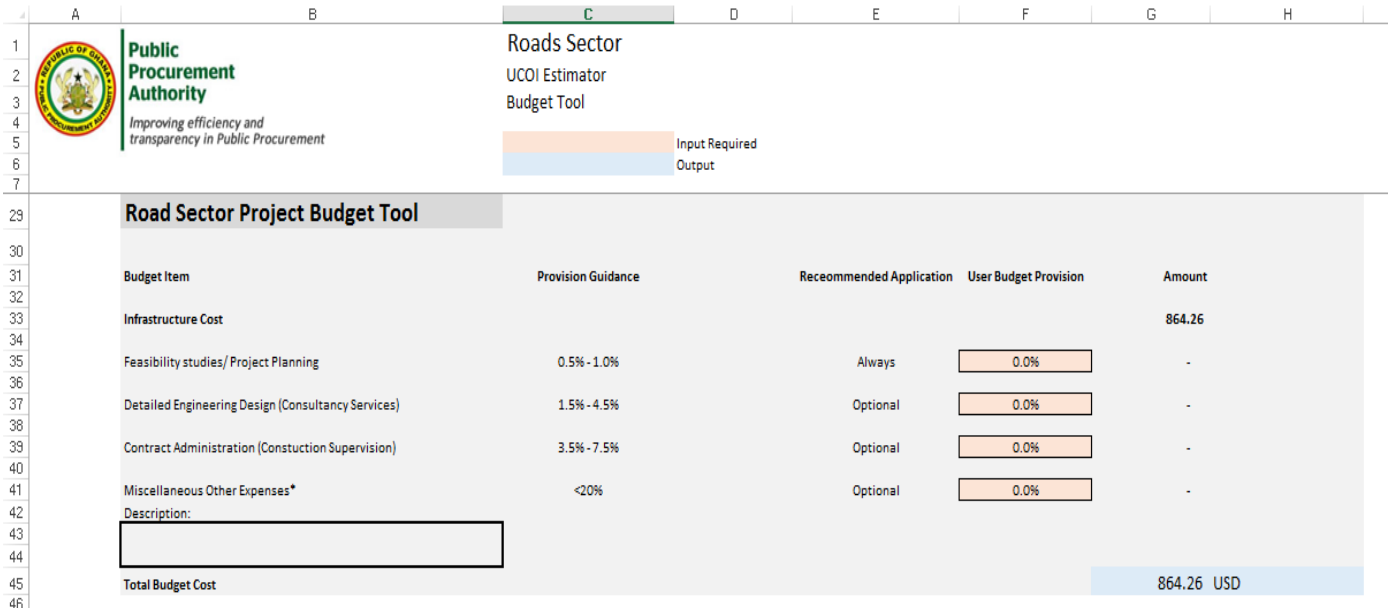
Provision was made as a guide to what proportion of the initial infrastructure cost should be allocated to the above items. These options can be seen under the **'Provision Guidance'** header. These help the user apply some informed basis to selecting an appropriate percentage value where his or her input is required for the applicable item under the **'User Budget Provision'**.

The budget tool for the road sector also allows the user to enter any additional items that may not fall within the three items above set within the project budget tool for the roads sector. These include items such as:

- Inflation;
- Extension of time; and
- Utility Relocation, etc.

Below is a screenshot of the road sector budget tool.

Figure 3-2: User Interface of the Roads Sector Project Budget tool



Public Procurement Authority
Improving efficiency and transparency in Public Procurement

Roads Sector
UCOI Estimator
Budget Tool

Input Required
Output

Road Sector Project Budget Tool

Budget Item	Provision Guidance	Receommended Application	User Budget Provision	Amount
Infrastructure Cost				864.26
Feasibility studies/ Project Planning	0.5% - 1.0%	Always	0.0%	-
Detailed Engineering Design (Consultancy Services)	1.5% - 4.5%	Optional	0.0%	-
Contract Administration (Constuction Supervision)	3.5% - 7.5%	Optional	0.0%	-
Miscellaneous Other Expenses*	<20%	Optional	0.0%	-
Description:				
Total Budget Cost				864.26 USD

3.2. How to use the Road Sector Unit Cost Estimator

The first stage of interaction with the road sector unit cost estimator is to select the applicable option for each cost driver listed. The road sector unit cost tool has 8 user selected/input required items which inform the computed unit cost for the sector. Out of these 8 user selected/input required items, 7 of them are drop-downs from which the user has to select options under those items.

The dropdown items include:

- The delivering Road Agency/Authority **[Road Agency Authority]**;
- The intervention type applied **[Intervention Type]**;
- The surface type used **[Surface Type]**;
- The nature of the surfacing **[Surfacing]**;
- Administrative region **[Region]**;
- Funding source **[Funded by]**;
- Carriageway Type **[Carriageway]**

The options for each of the dropdowns are listed in Table 3-1 below.

Figure 3-3: User selected section-Road Sector Unit Cost Estimator

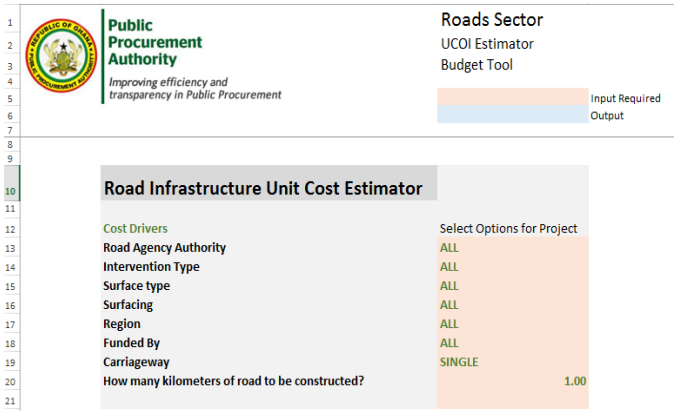


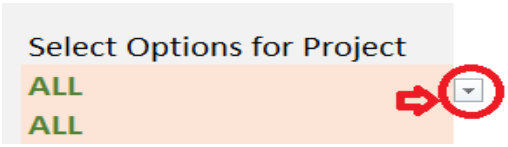
Table 3-1: Road Unit Cost- Cost Driver Item and Corresponding Drop-down Options

Cost Driver Item	Drop down Options	
Road Agency Authority	ALL (All Agencies/Authorities)	
	Department of Feeder Roads (DFR)	
	Department of Urban Roads (DUR)	
	Ghana Highways Authority (GHA)	
Intervention Type	ALL (All Intervention types)	Construction
	Overlay	Part Reconstruction (Partial Reconstruction)
	Reconstruction	Grading
	Regravel (Regravelling)	Rehabilitation
	Resealing	Reshaping
	Routine Maintenance	Spot Improvement
	Surfacing	Upgrading
Surface Type	ALL (All Surface types)	
	Paved	
	Unpaved	
Surfacing	ALL (All Surfacing)	ACC (Asphalt Cement Concrete)
	DSD (Double Surface Dressing)	GRAV (Gravelling)
	OVERLAY	CONCRETE
	SSD (Single Surface Dressing)	
Region	ALL (All regions)	AR (Ashanti Region)
	BAR (Brong Ahafo Region)	CR (Central Region)
	ER (Eastern Region)	GAR (Greater Accra Region)

Cost Driver Item	Drop down Options	
	NR (Norther Region)	UER (Upper East Region)
	UWR (Upper West Region)	VR (Volta Region)
	WR (Western Region)	
Funded by	ALL (All Funding sources)	CCB (COCOBOD)
	CF (Consolidated Fund)	GOG (Government of Ghana)
	RF (Road Fund)	OTHER
Carriageway	SINGLE	

Please note that when the 'ALL' option is selected for any criteria it selects all historical contracts with have all with all the applicable drop down options in computing the unit cost.

Figure 3-4: Drop down button selector



In order to select any item from the dropdown options, move your mouse cursor to the cell below the header 'Select Options for Project' in line with a corresponding cos driver. A downward pointing arrow will appear on the right side of the cell (See Figure 3-4).

Click on the downward pointing arrow to activate the list of dropdowns. See Figure 3-5 below (*Suggestion: in order to make the dropdowns more visible you can increase the magnification/ zoom of the Excel spreadsheet*).

Figure 3-5: Activated drop down options selection

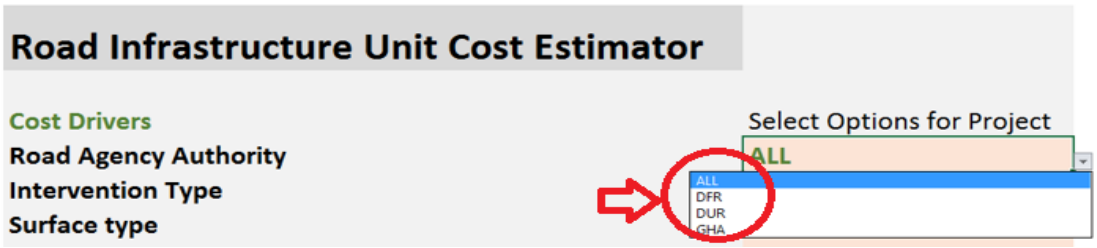
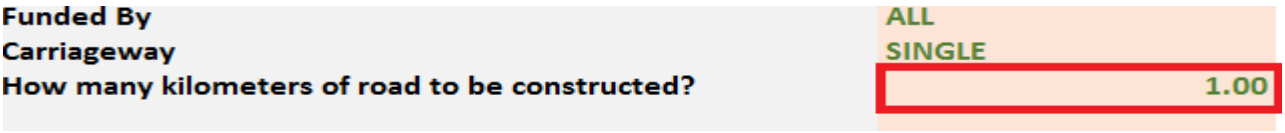


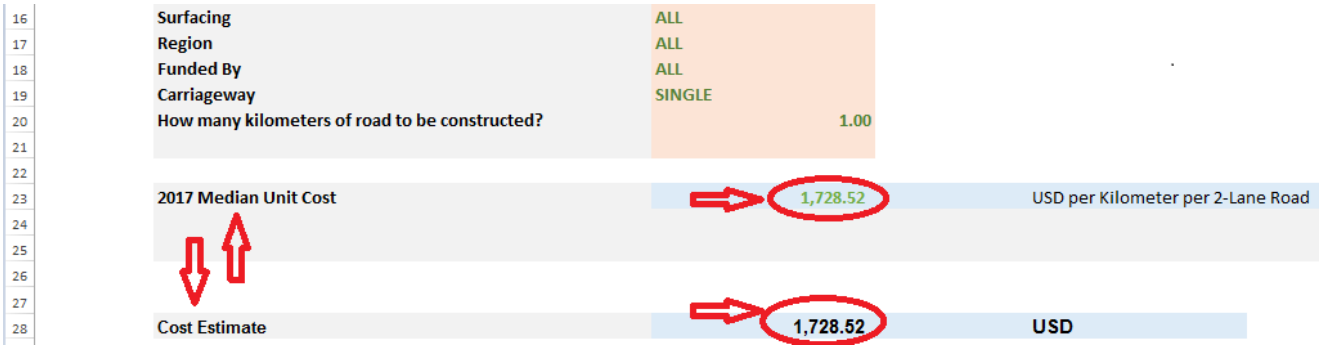
Figure 3-6: User Input Section – Road Sector Unit Cost Estimator



Once the respective options for each of the corresponding cost drivers have been selected, the user enters the number of kilometres of the project **'How many kilometres of road to be constructed'** in the input area highlighted in red in figure 3-6 above. The Roads sector unit cost tool will then report a unit cost estimate i.e. '**2017 Median Unit Cost'** of the project**.**

Depending on the number of kilometres entered in the corresponding cell inputs, the unit cost of the road project will also change as well as the **'Cost estimate'** item which reflects the total cost of the road infrastructure being reviewed in the tool. (See Figure 3-7 below)

Figure 3-7: Road Sector Unit Cost and Cost Estimate Output



3.2.1. Summary of Steps-Road Sector Unit Cost Estimator

1. Select the options for each cost driver with a drop-down (e.g. Road Agency Authority, Surfacing, Region, etc.) as may apply to your scenario;
2. At the **'How many kilometres of road to be constructed?'** query enter the road length to be constructed in the input required section; and
3. The Median Unit Cost will be produced for USD per kilometre per 2-lane road as well as the Cost Estimate that will be incurred for constructing a road project with the user selected characteristics.

Key Points to note on the use of the Road Sector Unit Cost Estimator

- It is recommended that the tool should be used by a technical person who understands and can interpret the content. All results and interpretations are the sole responsibility of the user;
- The contract cost data used comprise solely of project costs for various interventions at the **award prices**. It therefore expresses the unit cost of the intervention without consideration of any variations, extensions of time or any other changes to the original contract awarded;
- For this current version of the tool, the scope of the data is confined to projects for the various interventions for **only 2-lane single carriageway roads;**
- Output of unit cost estimator for the road sector feeds into the budget tool. The road sector unit cost is expressed in **USD/km** whilst budget tool estimate is expressed in **USD** for full length of intervention type;

- The output of unit cost per intervention type is the calculated median value of all relevant cost values. It does not report the average/mean cost;
- To avoid errors, it is suggested that the user systematically selects the various components logical sequence from top to down;
- As much as possible, no selection should indicate **ALL.** Any cell showing that should be change to a specific descriptor;
- It is assumed that the user knows which options for each cost driver go with other cost drivers for e.g. not selecting wrong options such as PAVED for **'Surface Type'** and then selecting GRAVEL for **'Surfacing'**; and
- It should be noted that where there is no contract in the database that satisfies the unique set of parameters the user has entered, no unit cost estimate will be reported. This may be resolved in the future update of the database as more contract data is collected and analysed. It should be remembered that this tool reports on similar real contracts found in its database.

3.3. How to use the Road Sector Budget Tool

The cost estimate derived from the unit cost estimator feeds into the budget tool as the **'Infrastructure Cost'.** Users are only required to provide input in the form of percentages for the 8 budget line items as highlighted in Figure 3-8 at the **'User Budget Provision'** column of the tool. As mentioned earlier, the **'Provision guidance'** provided should enable the user to apply some informed basis to select an appropriate percentage required under the **'User Budget Provision.**

The budget line items for which users would provide the input for include:

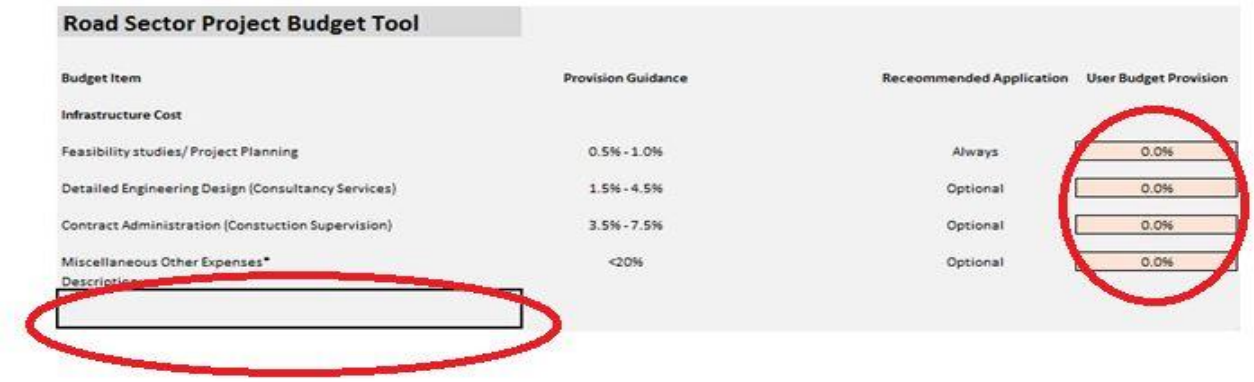
- Feasibility Studies/Project Planning;
- Detailed Engineering Design (Consultancy Services);
- Contract Administration (Construction Supervision); and
- Miscellaneous Other Expenses.

Additionally, the budget tool for the roads sector also allows the user to enter any additional items that may not fall within the items above set within the project budget tool for the sector. These include items such as:

- Inflation;
- Extension of time;
- Force Majeure;
- Defective Design;
- Resettlement Compensation;
- Utility Relocation; and
- Delayed Payment etc.

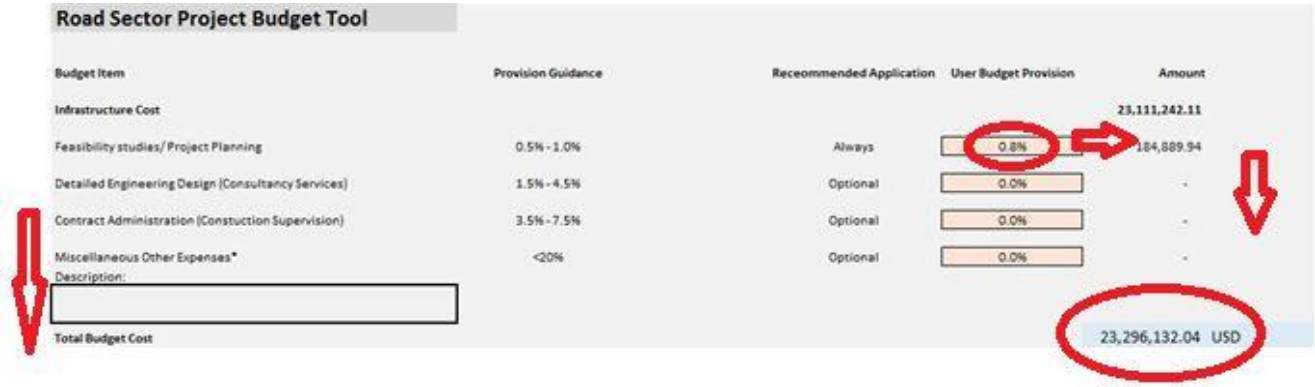
This input area for the budget line item as can be seen in figure 3-8 below.

Figure 3-8: User Input Section-Road Sector Budget Tool



Once the user inputs the budget provision percentages for each of the corresponding budget line items, the road sector budget tool will report a budget estimate i.e. '**Total Budget Cost'.** The total budget cost is derived from the outcomes of the budget line items calculated as percentages of the Infrastructure Cost and added to the infrastructure cost amount obtained from the unit cost estimator (See Figure 3-9 below).

Figure 3-9: Road Sector Total Budget Cost Output



Key Points to note on the use of the Road Sector Budget Tool

- Apart from Project Planning/Feasibility Studies, all the other budget line items are optional. In scenarios where Project Planning/Feasibility Studies have already been covered under the allocation for the project, users are not required to make any allocation for it in the budget tool. However, for some projects, this is assigned as an Administrative Cost;
- For consultancy services for design studies that do not include construction supervision, use the option **Detailed Engineering Design (Consultancy Services);**
- For consultancy services meant for the supervision of the construction of works only, use the option **Contract Administration;** and
- In cases where consultancy services are for both design and construction supervision, then both options 2 and 3 above should be used accordingly.

4. Buildings Sector Unit Cost Estimator and Budget Tool

4. Buildings Sector Unit Cost Estimator and Budget Tool

4.1. User interface

4.1.1. Buildings Sector Unit Cost Estimator

The buildings sector unit cost estimator similarly was developed with the data segmentation modelling approach. This approach was adopted because a moderately sized historical record of contracts with a reasonable number of cost drivers that reflect the nature of the buildings sector in Ghana was obtained.

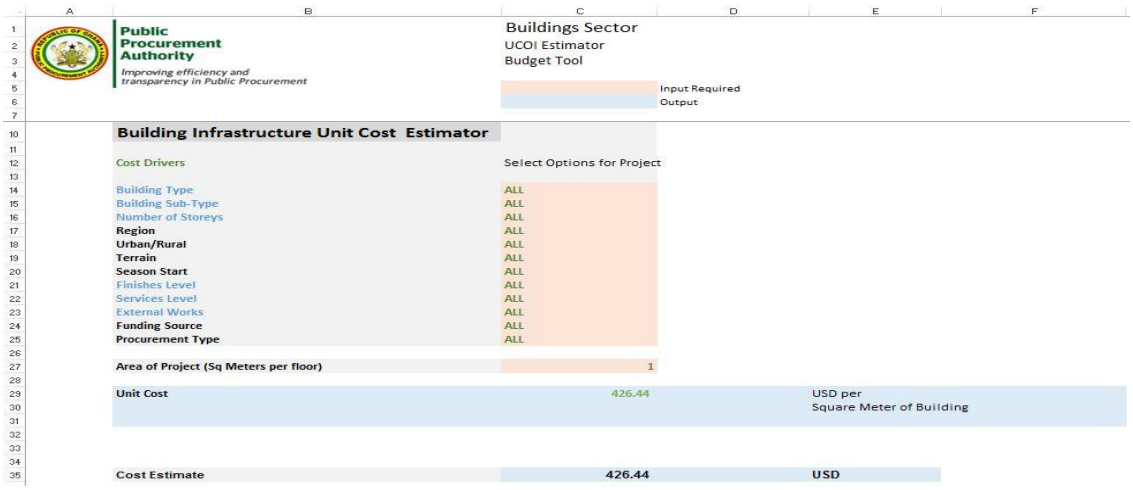
The historical buildings contract data was stratified into groups defined by the value of cost drivers and the median historical inflation-adjusted project costs used to estimate the unit cost of infrastructure for a building project belonging to the identified segment.

The main cost drivers identified for the buildings sector include the following:

- Type of Building Infrastructure;
- Building Sub-Type;
- Number of Storeys;
- Region;
- Urban/Rural;
- Terrain;
- Season Start;
- Finishes Level;
- Services Level;
- External works;
- Funding Source;
- Procurement Type; and
- Area of Project (Sq. Metres per floor) – *User Input*

A screen shot of the user interface for the buildings sector unit cost estimator is shown below with the selectable cost drivers and the window where the unit cost output is presented after selecting the applicable drivers.

Figure 4-1: User Interface of the Buildings Sector Unit Cost Estimator



4.1.2. Buildings Sector Budget Tool

The buildings sector budget tool allows the user to include the cost of other factors that relate to the development of the building project. The budget tool under this project was developed based on the experience of buildings sector experts as well as based on interaction with the key stakeholders in the sector in Ghana.

The pre-set elements of the buildings sector project budget tool include budget allocation for:

- Project Formulation/Preparation;
- Project Coordination Unit (PCU) – Management and Monitoring;
- Implementing Metro/Municipal/District Assembly;
- Consultants – Pre-Contract Phase;
- Consultants – Post-Contract Phase;
- Post Contract Follow-up Activities by PCU; and
- Potential Stakeholder Engagement.

Provision was made as a guide as to what proportion of the initial infrastructure cost should be allocated to the above items. These options can be seen under the **'Provision Guidance'** header. This enables the user to apply some informed basis to selecting an appropriate percentage where his or her input is required under the **'User Budget Provision'**. Here, the user can enter a percentage value for any of the applicable items provided.

The budget tool for the buildings sector also allows the user to enter any additional items that may not fall within the items above set within the project budget tool for the buildings sector. These include items such as:

- Relocation of underground utility services e.g. Water, telephone cables etc.
- Relocation of underground drainage works; and
- Any other item not covered in the budget.

Below is a screenshot of the buildings sector budget tool.

Figure 4-2: User Interface of the Buildings Sector Project Budget tool

Public Procurement Authority
Improving efficiency and transparency in Public Procurement

Buildings Sector
UCOI Estimator
Budget Tool

Input Required
Output

Buildings Sector Project Budget Tool

Budget Item	Provision Guidance	Application	User Budget Provision	Amount
Total Infrastructure Cost				**426.44**
Project Formulation/Preparation	1.0%	Always	0.0%	-
Project Coordination Unit (PCU); Management and Monitoring	3.0%	Always	0.0%	-
Implementing Metro/Municipal/District Assembly sub-office	1.5%	Optional	0.0%	-
Consultants; Pre-Contract Phase	3.0%	Always	0.0%	-
Consultants; Post-Contract Phase	5.0%	Always	0.0%	-
Post Contract Follow-up activities by PCU	1.0%	Optional	0.0%	-
Potential stakeholder engagement	0.5%	Optional		-
	1% - 3%	Depends on Strategy	0.0%	-
Total Budget Cost			0.0%	426.44 USD

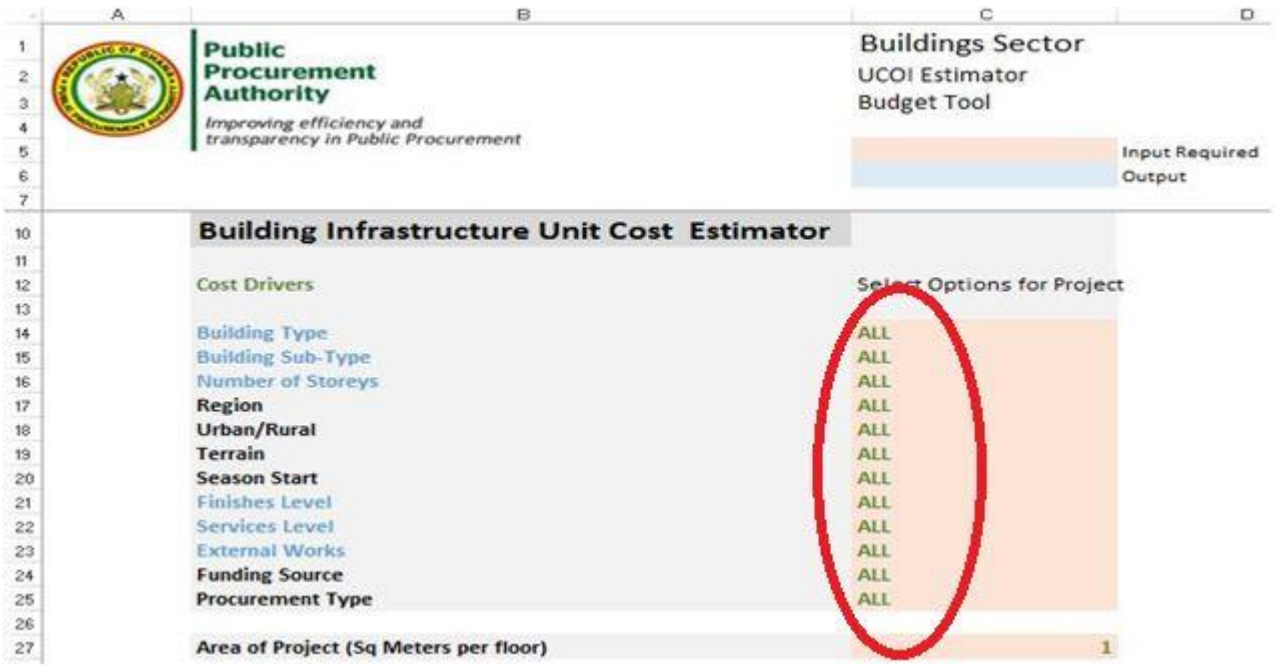
4.2. How to use the Buildings Sector Unit Cost Estimator

The first stage of interaction with the buildings sector unit cost estimator is to select the applicable option for each cost driver listed. The buildings sector unit cost tool has 13 user selected/input required items which inform the computed unit cost for the sector. Out of these 13 user selected/input required items, 12 of them are drop-downs from which the user has to select the options under those items.

The dropdown items include:

- General Type of building **[Building Type];**
- Specific Type of building **[Building Sub-Type];**
- Number of storeys for the building **[Number of Storeys];**
- Administrative region **[Region];**
- Nature of the building's location **[Urban/Rural];**
- Type of terrain for the building **[Terrain];**
- Type of season project starts **[Season Start];**
- Level of building finish to be applied **[Finishes Level];**
- Building service level to be applied **[Services Level];**
- Level of building external works to be applied **[External works];**
- The funding organisation for the building project **[Funding Source];** and
- Method of procurement being applied **[Procurement Type].**

Figure 4-3: User selected section-Buildings Sector Unit Cost Estimator



The options for each of the dropdowns are listed in Table 4-1 below.

Table 4-1: Buildings Unit Cost- Cost Driver Item and Corresponding Drop-down Options

Cost Driver Item	Drop down Options	
Building Type	ALL (BUILDING TYPES)	
	RESIDENTIAL	
	COMMERCIAL	
	EDUCATIONAL	
	GENERAL	
	HEALTH	
	INDUSTRIAL	
	OFFICE	
	SPORTS	
Building Sub-Type	ALL (ALL BUILDING SUB-TYPES)	FENCE WALL
	ADMINISTRATION BLOCK	HOSPITAL
	APARTMENTS	HOSTEL
	ASSEMBLY HALL	LABORATORY BLOCK
	AUDITORIUM BLOCK	LECTURE HALL
	BUNGALOW	MARKET
	CAR PARK	OFFICE
	CLASSROOM	SEMI-DETACHED
	CONFERENCE CENTRE	SPORTS
	DORMITORY	STAFF
	EXAMINATION HALL	STORES
	DINING HALL	TRAINING CENTRE
	FACULTY	
Number of Storeys	ALL (ALL NUMBER OF STOREYS)	
	1 (One)	
	2 (Two)	
	3 (Three)	
	4 (Four)	
	5 (Five)	
	6 (Six)	
Region	ALL (ALL REGIONS)	NORTHERN
	GREATER ACCRA	BRONG AHAFO
	CENTRAL	UPPER EAST
	VOLTA	UPPER WEST
	EASTERN	ASHANTI
Urban/Rural	ALL (ALL URBAN/RURAL)	

Cost Driver Item	Drop down Options	
	URBAN	RURAL
Terrain	ALL (ALL TERRAINS)	
	NORMAL	
	ABNORMAL	
Season Start	ALL (ALL SEASONS)	
	DRY	
	WET	
Finishes Level	ALL (ALL FINISHES LEVELS)	MEDIUM
	LOW	HIGH
Services Level	ALL (ALL SERVICES LEVELS)	MEDIUM
	LOW	HIGH
External Works	ALL (ALL EXTERNAL WORKS)	MEDIUM
	LOW	HIGH
Funding Source	ALL (ALL FUNDING SOURCES)	GOG
	GETFUND	SSNIT
	M.O.E	OTHER
	WORLD BANK	
Procurement Type	ALL (ALL PROCUREMENT TYPES)	
	NATIONAL COMPETITION	
	PPP	
	SELECTIVE TENDER	

Please note that when the 'ALL' option is selected for any criteria it selects all historical contracts with all the applicable drop down options in computing the unit cost.

In order to select any item from the dropdown options, move your mouse cursor to the cell below the header 'Select Options for Project' in line with a corresponding cost driver. A downward pointing arrow will appear on the right side of the cell (See Figure 4-4).

Click on the downward pointing arrow to activate the list of dropdowns. See Figure 4-5 below (*Suggestion: in order to make the dropdown options more visible you can increase the magnification/ zoom of the Excel spreadsheet*).

Figure 4-4: Drop down button selector

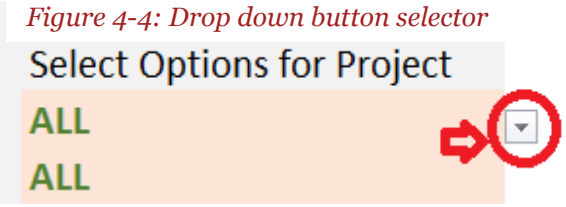
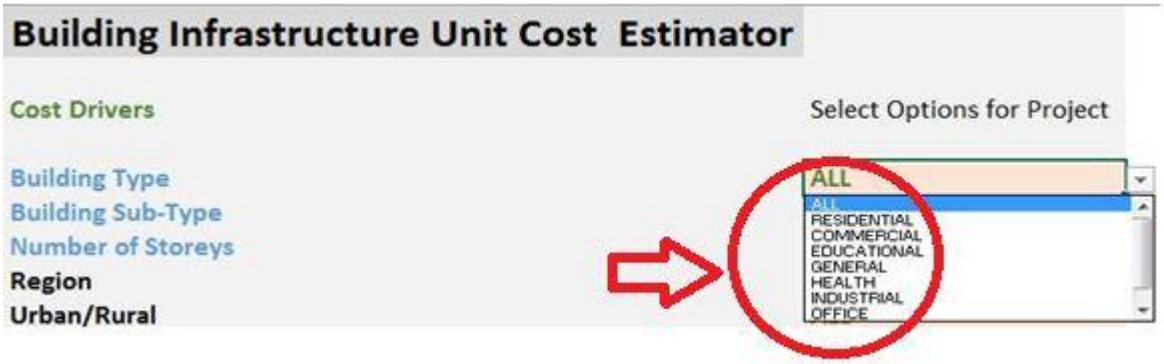
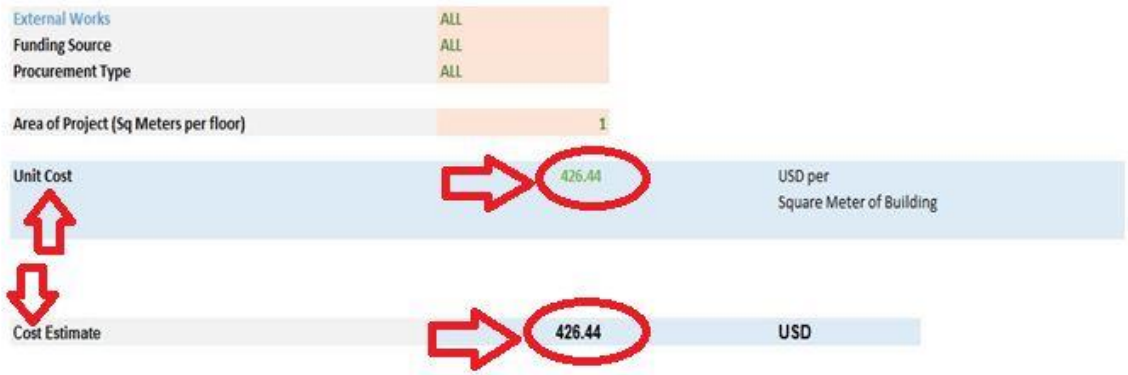


Figure 4-5: Activated drop down options selection



Once the user selects options for each of the corresponding cost drivers, the buildings sector unit cost tool will report a unit cost estimate i.e. '**Unit Cost'.** This value is reported just below the 'Area of Project (Sq. Metres per floor)' cost driver. Depending on the number of square metres per floor **(Area of Project (Sq. Metres per floor)** entered in the corresponding cell inputs, the unit cost of the building project will also change as well as the **'Cost estimate'** item which reflects the total cost of the building infrastructure being reviewed in the tool. (See Figure 4-6 below)

Figure 4-6: Buildings Sector Unit Cost and Cost Estimate Output



4.2.1. Summary of Steps-Buildings Sector Unit Cost Estimator

1. Select the options for each cost driver with a drop-down (e.g. Building type, Building sub-type, Number of Storeys etc.) as may apply to your scenario.
2. At the **Area of project (Square metres per floor)** query, enter the floor area to be constructed in the input required section.
3. The Unit Cost will be produced for USD per square metre of building as well as the total cost estimate that will be incurred for constructing the building project with the user selected characteristics.

Key Points to note on the use of the Buildings Sector Unit Cost Estimator

- It is recommended that the tool should be used by a technical person who understands and can interpret the content. All results and interpretations are the sole responsibility of the user;
- The contract cost data used comprise solely of project costs for various building infrastructure at the **award prices**. It therefore expresses the unit cost of providing the building infrastructure without consideration of any variations, extensions of time or any other changes to the original contract awarded;

- Output of unit cost estimator for the buildings sector feeds into the budget tool. The buildings sector unit cost is expressed in **USD/m²** whilst the budget tool estimate is expressed in **USD**;
- The output of unit cost per building infrastructure type is the calculated median value of all relevant cost values. It does not report the average/mean cost;
- To avoid errors, it is suggested that the user systematically selects the various components logical sequence from top to down;
- As much as possible, no selection should indicate **ALL.** Any cell showing that should be changed to a specific descriptor;
- It is assumed that the user knows which options for each cost driver go with other cost drivers for e.g. not to select wrong options such as RESIDENTIAL for **'Building Type'** and then selecting CLASSROOM for **'Building Sub-Type'**;
- It should be noted that where there is no contract in the database that satisfies the unique set of parameters the user has entered, no unit cost estimate will be reported. This may be resolved in the future update of the database as more contract data is collected and analysed. It should be remembered that this tool reports on similar real contracts found in its database.

4.3. How to use the Buildings Sector Budget Tool

The cost estimate derived from the unit cost estimator feeds into the budget tool as the **'Total Infrastructure Cost'.** Users are only required to provide input in the form of percentages for the 8 budget line items as highlighted in Figure 4-7 below at the **'User Budget Provision'** column of the tool. As mentioned earlier, the **'Provision guidance'** provided should enable the user to apply some informed basis to select an appropriate percentage required under the **'User Budget Provision.**

The budget line items for which users would provide input for include:

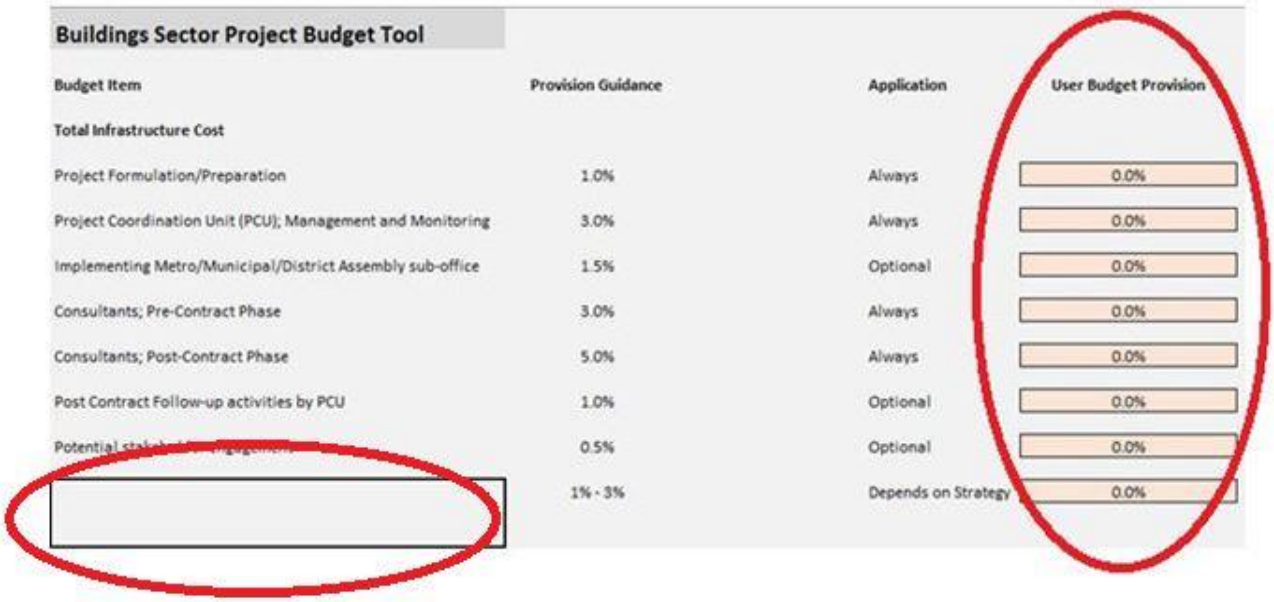
- Project Formulation/Preparation;
- Project Coordination Unit (PCU) – Management and Monitoring;
- Implementing Metro/Municipal/District Assembly;
- Consultants – Pre-Contract Phase;
- Consultants – Post-Contract Phase;
- Post Contract Follow-up Activities by PCU; and
- Potential Stakeholder Engagement.

Additionally, the budget tool for the buildings sector allows the user to enter any additional items that may not fall within the items above set within the project budget tool for the buildings sector. These include items such as:

- Relocation of underground utility services e.g. Water, telephone cables etc.
- Relocation of underground drainage works; and
- Any other item not covered in the budget.

These input area for the budget line item as can be seen in Figure 4-7 below.

Figure 4-7: User Input Section-Buildings Sector Budget Tool

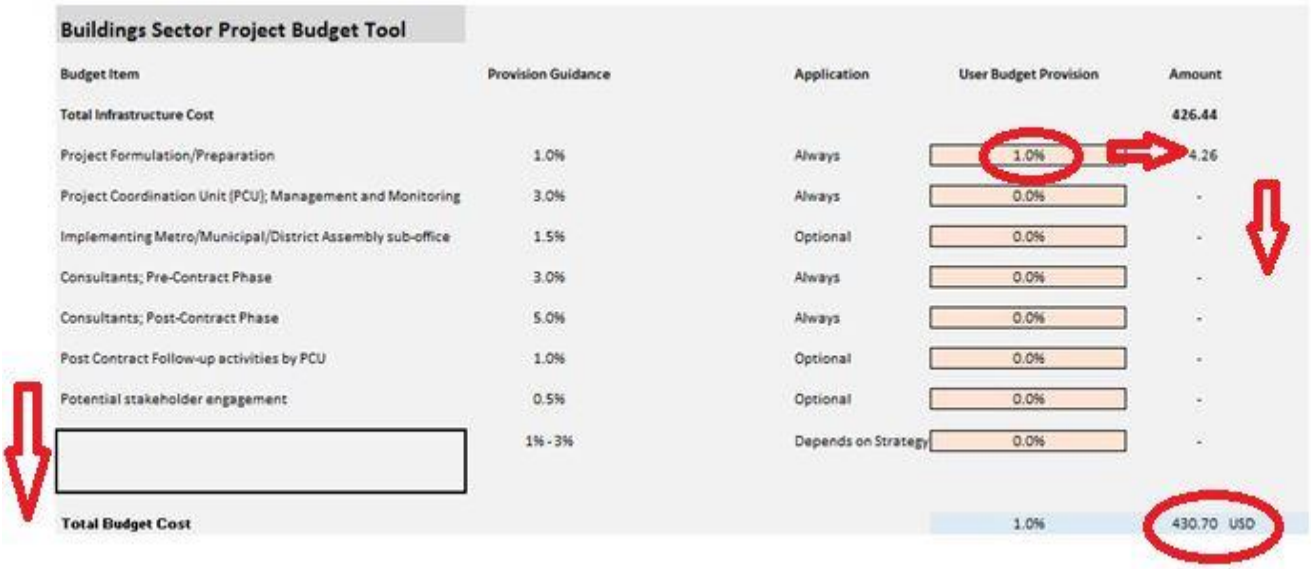


Buildings Sector Project Budget Tool

Budget Item	Provision Guidance	Application	User Budget Provision
Total Infrastructure Cost			
Project Formulation/Preparation	1.0%	Always	0.0%
Project Coordination Unit (PCU); Management and Monitoring	3.0%	Always	0.0%
Implementing Metro/Municipal/District Assembly sub-office	1.5%	Optional	0.0%
Consultants; Pre-Contract Phase	3.0%	Always	0.0%
Consultants; Post-Contract Phase	5.0%	Always	0.0%
Post Contract Follow-up activities by PCU	1.0%	Optional	0.0%
Potential stak[illegible] engagement	0.5%	Optional	0.0%
	1% - 3%	Depends on Strategy	0.0%

Once the user inputs the budget provision percentages for each of the corresponding budget line items, the buildings sector budget tool will report a budget estimate i.e. '**Total Budget Cost'.** The total budget cost will be derived from the outcomes of the budget line items calculated as percentages of the Total Infrastructure Cost and added to the total infrastructure cost amount obtained from the unit cost estimator (See Figure 4-8 below).

Figure 4-8: Buildings Sector Total Budget Cost Output



Buildings Sector Project Budget Tool

Budget Item	Provision Guidance	Application	User Budget Provision	Amount
Total Infrastructure Cost				**426.44**
Project Formulation/Preparation	1.0%	Always	1.0%	4.26
Project Coordination Unit (PCU); Management and Monitoring	3.0%	Always	0.0%	-
Implementing Metro/Municipal/District Assembly sub-office	1.5%	Optional	0.0%	-
Consultants; Pre-Contract Phase	3.0%	Always	0.0%	-
Consultants; Post-Contract Phase	5.0%	Always	0.0%	-
Post Contract Follow-up activities by PCU	1.0%	Optional	0.0%	-
Potential stakeholder engagement	0.5%	Optional	0.0%	-
	1% - 3%	Depends on Strategy	0.0%	-
Total Budget Cost			1.0%	430.70 USD

Key Points to note on the use of the Buildings Sector Budget Tool

- Output of the unit cost estimator for the buildings sector feeds into the budget tool. The buildings sector unit cost is expressed in **USD/m²** whilst the budget tool estimate is expressed in **USD**;
- To avoid errors, it is suggested that the user only inputs the absolute values i.e. 1, 2, 3 etc. for the various components in the applicable areas; and
- It is also recommended that users consider the provision guidance in making their input. It is worth noting that these guidelines were derived based on expert experience as well as from interactions with key stakeholders within the sector.

5. Water Sector Unit Cost Estimator and Budget Tool

5. Water Sector Unit Cost Estimator and Budget Tool

5.1. User Interface

5.1.1. Water Sector Unit Cost Estimator

The water Sector cost estimator was developed with the Component Cost modelling approach. This approach was adopted because a moderate number of contracts with a reasonable number of cost drivers that reflect the nature of the water sector in Ghana. In this approach, an exhaustive list of project components was developed and component costs derived from the mostly standard priced Bill of Quantities in the contract documents obtained from sector agencies."

The water unit cost estimator has been designed to reflect the main systems indicative of the sector as follows:

- Conventional Town Water Systems; and
- Point Source System

The main cost drivers the analysis of the water sector identified under the above mentioned systems is shown in the following table.

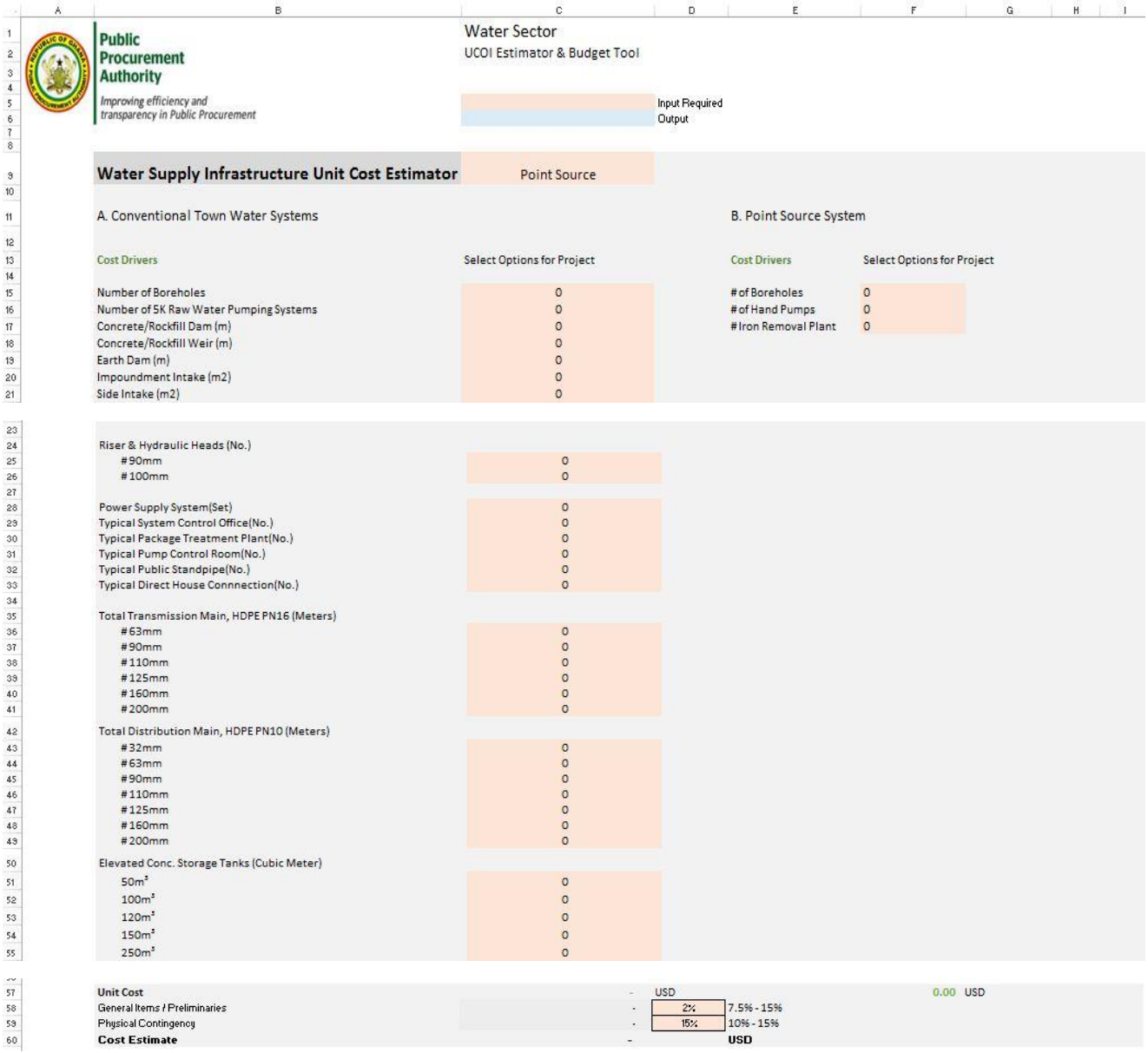
Table 5-1: Water Sector Unit Cost Drivers (Components)

No.	Conventional Town Water Systems	Point Source System
1	Number of Boreholes	Number of Boreholes
2	Number of 5K Raw Water Pumping Systems	Number of Hand Pumps
3	Concrete/Rockfill Dam (m)	Number of Iron Removal Plant
4	Concrete/Rockfill Weir (m)	
5	Impoundment Intake (m2)	
6	Side Intake (m2)	
7	Riser and Hydraulic Heads (No.): • *#90mm* • *#100mm*	
8	Power Supply System (Set)	
9	Typical System Control Office (No.)	
10	Typical Package Treatment Plant (No.)	
11	Typical Pump Control Room (No.)	
12	Typical Public Standpipe (No.)	
13	Typical Direct House Connection (No.)	
14	Total Transmission Main, HDPE PN16 (Metres): • *# 63mm* • *# 90mm* • *# 110mm* • *# 125mm* • *# 160mm* • *# 200mm*	
15	Total Distribution Main, HDPE PN10 (Metres): • *# 32mm* • *# 63mm* • *# 90mm* • *# 110mm* • *# 125mm* • *# 160mm* • *# 200mm*	

No.	Conventional Town Water Systems	Point Source System
16	Elevated Conc. Storage Tanks (Cubic Meter): • *50m3* • *100m3* • *120m3* • *150m3* • *250m3*	

Screen shots of the user interface for the water sector unit cost estimator are shown below with the respective cost drivers and the window where the unit cost output is presented.

Figure 5-1: User Interface of the Water Sector Unit Cost Estimator



5.1.2. Water Sector Budget Tool

The water sector budget tool allows the user to include the cost of other factors that relate to the development of the water project. The budget tool under this project was also developed based on the experience of water sector experts as well as based on interactions with the key stakeholders in the sector in Ghana.

The pre-set elements of the buildings sector project budget tool include budget allocation for:

- Project Formulation/Preparation;
- Project Implementation Agency Management and Monitoring;
- Technical Assistance for Implementing Agency project management;
- Implementing agency sub-office(Regional Office) monitoring;
- Decentralized Local Authority Management of the project;
- Feasibility studies / Project Planning;
- Detailed Design;
- Post Contract Follow-up activities by Implementing Agency;
- Potential stakeholder engagement; and
- Others.

Provision was made as a guide to what proportion of the initial infrastructure cost should be allocated to the above items. These options can be seen under the **'Provision Guidance'** header. This enables the user to apply some informed basis to selecting an appropriate percentage where his or her input is required under the **'User Budget Provision'**. Here, the user can enter a percentage value for any of the applicable items provided.

The budget tool for the water sector also allows the user to enter any additional items that may not fall within the items above set within the project budget tool for the sector. These include items such as:

- Post Project O&M/Sustainability Monitoring/Support; and
- Project Environmental/Social Impact Support.

Below is a screenshot of the water sector budget tool.

Figure 5-2: User Interface of the Water Sector Budget Tool

Water Sector Project Budget Tool

Budget Item	Provision Guidance	Receommended Application	User Budget Provision	Amount
Infrastructure Cost				-
Project Formulation/Preparation	0.5% - 1%	Always	0.0%	-
Project Implementation Agency Management and Monitoring	1% - 3%	Always	0.0%	-
Technical Assistance for Implementing Agency project management	1% - 3%	Optional	0.0%	-
Implementing agency sub-office(Regional Office) monitoring	0.5% - 1%	Always	0.0%	-
Decentralized Local Authority Management of the project	0.5% - 1%	Depends on Strategy	0.0%	-
Feasibility studies / Project Planning	1% - 3%	Always	0.0%	-
Detailed Design	1% - 3%	Always	0.0%	-
Post Contract Follow-up activities by Implementing Agency	0.5% - 1%	Optional	0.0%	-
Potential stakeholder engagement	0.5% - 1%	Optional	0.0%	-
Other*:	Varies	Optional		-
Total Budget Cost				- USD

5.2. How to use the Water Sector Unit Cost Estimator

The first stage of interaction with the water unit cost estimator is to select the applicable type of water system for the project from a drop-down menu located at the upper section of the estimator. The options for the drop-down menu include:

- Conventional Town Water Supply System; and
- Point Source System.

In order to select any item from the dropdown options, move your mouse cursor to the coloured cell next to the header **'Water Supply Infrastructure Unit Cost Estimator'** and click on that cell. A downward pointing arrow will appear on the right side of the cell (See Figure 5-3).

Figure 5-3: Drop-down Button Selector

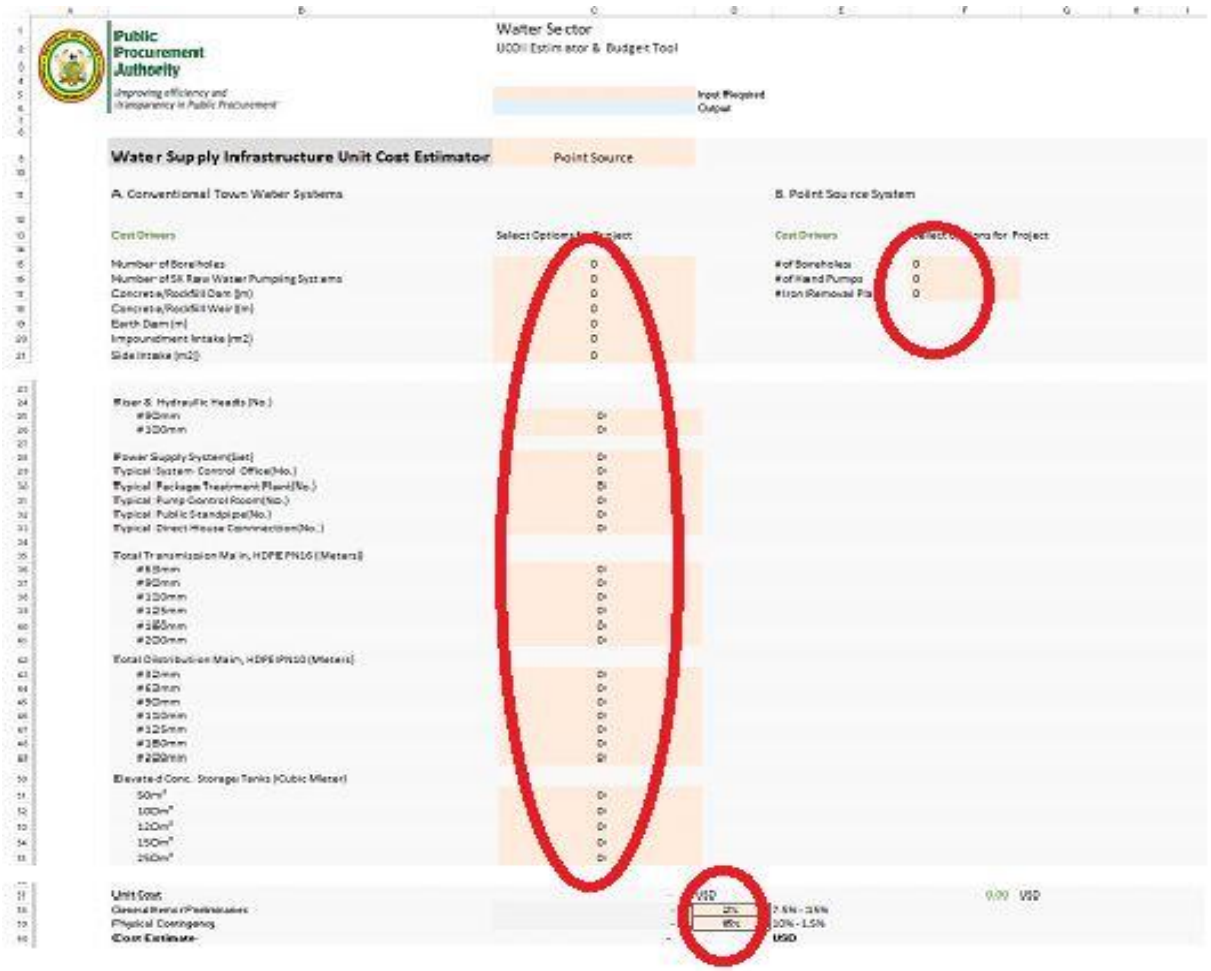
Click on the downward pointing arrow to activate the list of dropdowns. See Figure 5-4 below (*Suggestion: in order to make the dropdowns more visible you can increase the magnification/ zoom of the Excel spreadsheet*).

Figure 5-4: Activated drop down options selection (Point Source or Conventional Water System)

Once the dropdown list has been activated, the user can then select the applicable option and then proceed to input the applicable number or values for the cost drivers listed under the respective water supply system selected from the drop-down menu. It is imperative that users enter the numbers or values for the cost drivers that are specifically applicable to their identified project and system.

The input sections for the estimator are highlighted in Figure 5-5 as follows.

Figure 5-5: User input sections-Water Sector Unit Cost Estimator



Once the user enters the various values for each of the corresponding cost drivers under the selected system, the water sector unit cost tool will report a unit cost estimate i.e. '**Unit Cost'.** After establishing a unit cost, users must provide values for two key items namely '**General items/Preliminaries'** and '**Physical Contingency'** which are calculated as percentages of the unit cost determined to arrive at the **'Cost estimate'**. A range of values has been provided for this two items to guide users on the appropriate percentage values to input.

Depending on the values entered in the input sections, the unit cost of the water project will change as well as the **'Cost estimate'** item which reflects the total cost of the water infrastructure being reviewed in the tool. (See Figure 5-6 below)

Figure 5-6: Water Sector Unit Cost and Cost Estimate Output

5.2.1. Summary of Steps-Water Unit Cost Estimator

1. Select the option for the applicable water supply system from the drop-down menu (ie. Conventional Town Water Supply System and Point Source System);
2. Enter the applicable values or numbers in the input required section; and
3. The Unit Cost in USD will be produced as well as the total cost estimate that will be incurred for establishing the water infrastructure with the user selected characteristics.

Key Points to note on the use of the Water Sector Unit Cost Estimator

- It is recommended that the tool should be used by a technical person who understands and can interpret the content. All results and interpretations are the sole responsibility of the user;
- The contract cost data used comprise solely of project costs for various water infrastructure projects at the **award prices**. It therefore expresses the unit cost of providing the water infrastructure without consideration of any variations, extensions of time or any other changes to the original contract awarded;
- The output of the unit cost estimator for the water sector feeds into the budget tool. The water sector unit cost and budget tool estimate are expressed in **USD**;
- The output of unit cost per water infrastructure type is the calculated median value of all relevant cost values. It does not report the average/mean cost; and
- To avoid errors, it is suggested that the user only inputs the absolute values i.e. 1, 2, 3 etc. for the various components in the applicable areas.

5.3. How to use the Water Sector Budget Tool

The cost estimate derived from the unit cost estimator feeds into the budget tool as the **'Total Infrastructure Cost'.** Users are only required to provide input in the form of percentages for the 8 budget line items as highlighted in Figure 5-7 at the **'User Budget Provision'** column of the tool. As mentioned earlier, the **'Provision guidance'** provided should enable the user to apply some informed basis to select an appropriate percentage required under the **'User Budget Provision.**

The budget line items for which users would provide the input for include:

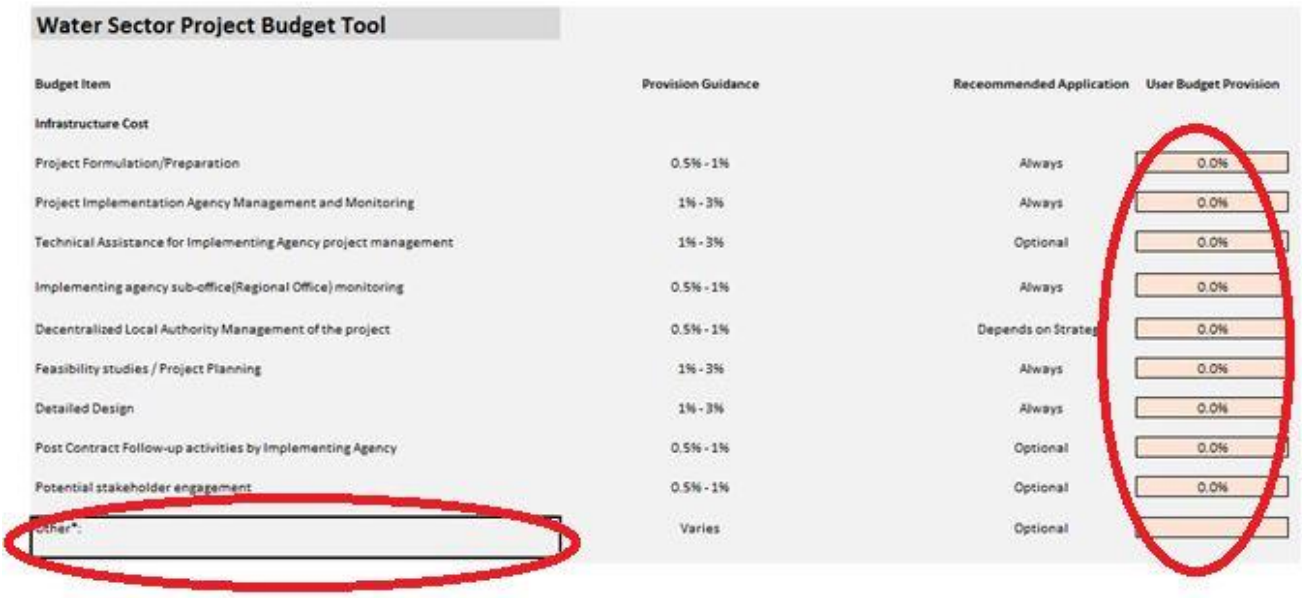
- Project Formulation/Preparation;
- Project Implementation Agency Management and Monitoring;
- Technical Assistance for Implementing Agency project management;
- Implementing agency sub-office(Regional Office) monitoring;
- Decentralized Local Authority Management of the project;
- Feasibility studies / Project Planning;
- Detailed Design;
- Post Contract Follow-up activities by Implementing Agency;
- Potential stakeholder engagement; and
- Others [User selected-Optional]

The budget tool for the water sector also allows the user to enter any additional items that may not fall within the items above set within the project budget tool for the sector. These include items such as:

- Post Project O&M/Sustainability Monitoring/Support; and
- Project Environmental/Social Impact Support.

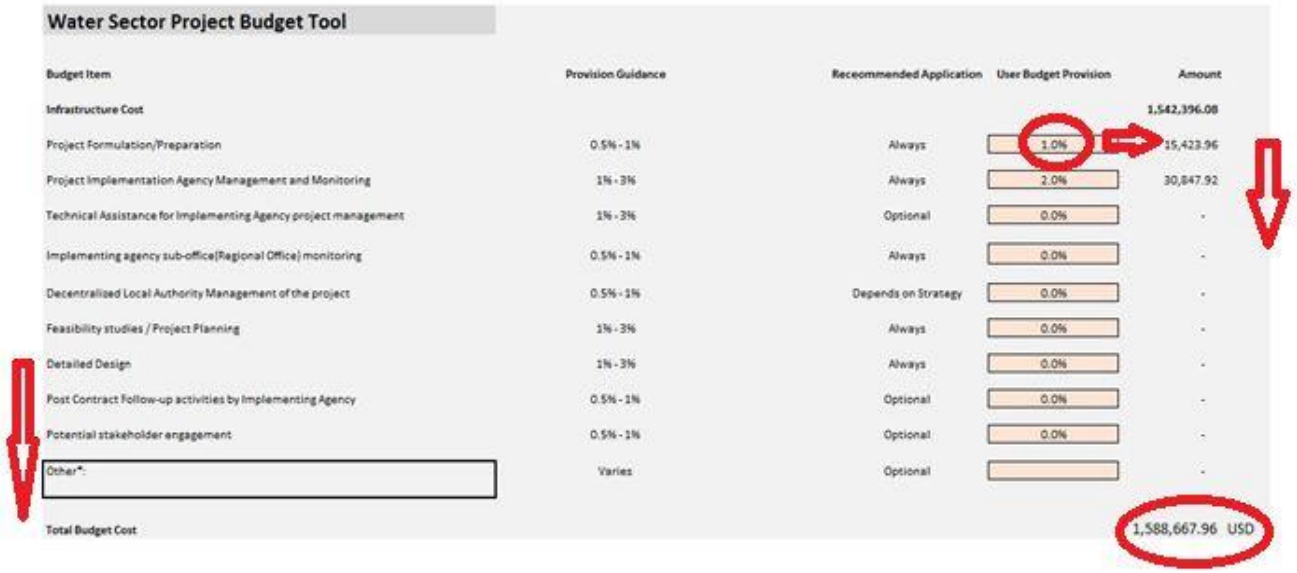
This input area for the budget line item as can be seen in Figure 5-7 below.

Figure 5-7: User Input Section - Water Sector Budget Tool



Once the user inputs the budget provision percentages for each of the corresponding budget line items, the water sector budget tool will report a budget estimate i.e. '**Total Budget Cost'.** The total budget cost will be derived from the outcomes of the budget line items calculated as percentages of the Total Infrastructure Cost and added to the total infrastructure cost amount obtained from the unit cost estimator (See Figure 5-8 below).

Figure 5-8: Water Sector Total Budget Cost Output



Water Sector Project Budget Tool

Budget Item	Provision Guidance	Recommended Application	User Budget Provision	Amount
Infrastructure Cost				1,542,396.08
Project Formulation/Preparation	0.5% - 1%	Always	1.0%	15,423.96
Project Implementation Agency Management and Monitoring	1% - 3%	Always	2.0%	30,847.92
Technical Assistance for Implementing Agency project management	1% - 3%	Optional	0.0%	-
Implementing agency sub-office(Regional Office) monitoring	0.5% - 1%	Always	0.0%	-
Decentralized Local Authority Management of the project	0.5% - 1%	Depends on Strategy	0.0%	-
Feasibility studies / Project Planning	1% - 3%	Always	0.0%	-
Detailed Design	1% - 3%	Always	0.0%	-
Post Contract Follow-up activities by Implementing Agency	0.5% - 1%	Optional	0.0%	-
Potential stakeholder engagement	0.5% - 1%	Optional	0.0%	-
Other*:	Varies	Optional		-
Total Budget Cost				1,588,667.96 USD

Key Points to note on the use of the Water Sector Budget Tool

- The output of the unit cost estimator for the water sector feeds into the budget tool. The water sector unit cost and budget tool estimate are expressed in **USD**;
- To avoid errors, it is suggested that the user only inputs the absolute values i.e. 1, 2, 3 etc. for the various components in the applicable areas; and
- It is also recommended that users consider the provision guidance in making their input. It is worth noting that these guidelines were derived based on expert experience as well as from interactions with key stakeholders within the sector.

6. Power Sector Unit Cost Estimator and Budget Tool

6. Power Sector Unit Cost Estimator and Budget Tool

6.1. User Interface-Power Distribution

6.1.1. Power-Distribution Unit Cost Estimator

The Unit Cost Estimator and Budget Tools for the Power Sector due to inherent characteristics was split into four categories namely:

- Power Generation;
- Power Distribution;
- Power Transmission 161Kv; and
- Power Sub-Transmission 33Kv.

Similar to the water sector unit cost estimator, the unit cost estimator for power distribution was developed using the Component Cost modelling approach. The minimal size of contracts obtained made it necessary to adopt this approach to enable the cost drivers that are representative of the power sector in Ghana to be determined from the available data,

As expected under this approach, an exhaustive list of project components was developed and current pricing from the market for components was used to build a complete project cost profile based on an item-by-item aggregation.

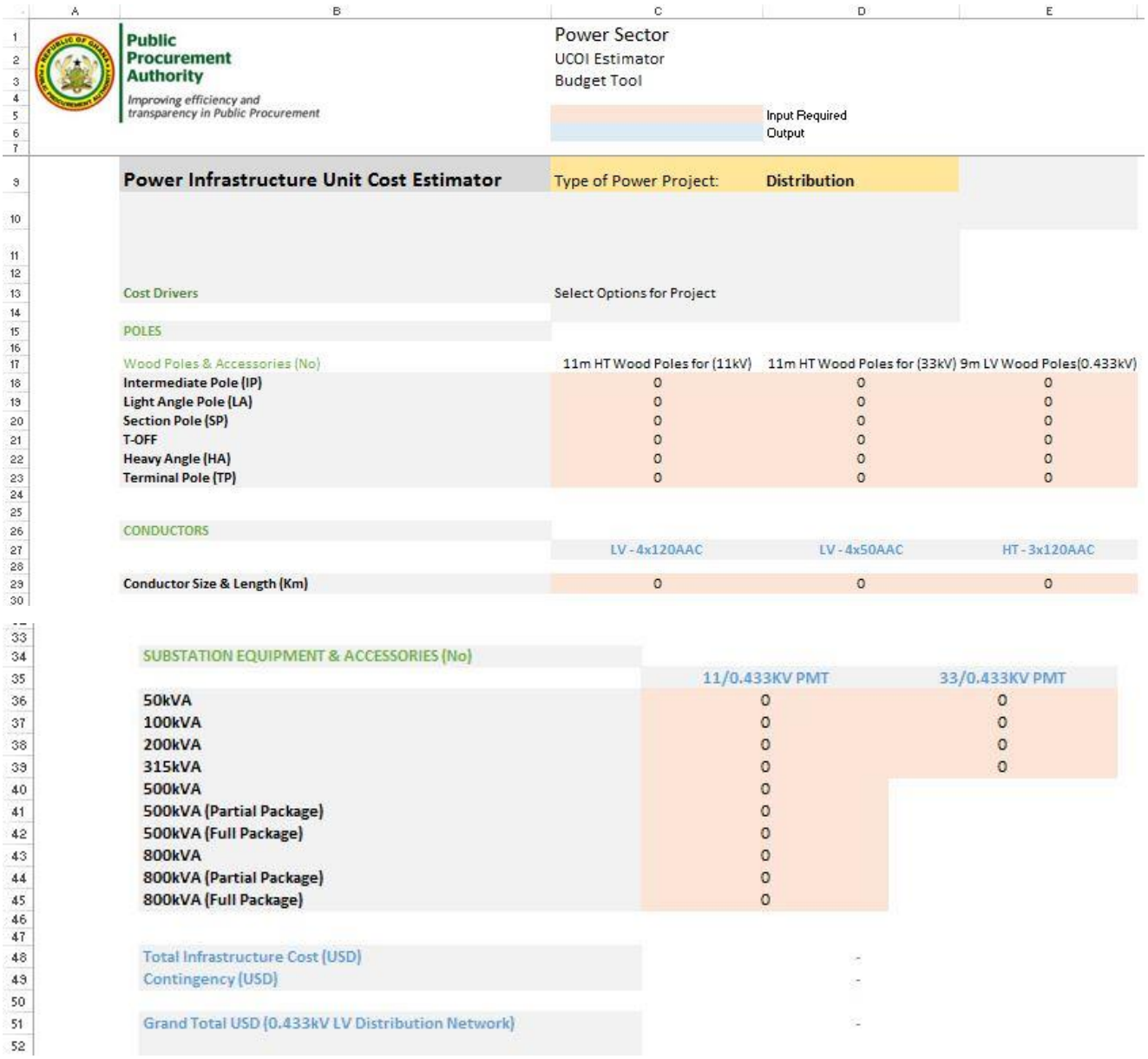
The main cost drivers identified from the analysis of the power distribution sector are shown in the following table.

Table 6-1: Power Distribution Sector Unit Cost Drivers and Components

No.	Cost Driver	Main Component	Sub-Components (Features)
1	Wood Poles & Accessories	• Intermediate Pole (IP) • Light Angle Pole (LA) • Section Pole (SP) • T-OFF • Heavy Angle (HA) • Terminal Pole (TP)	• 11m HT Wood Poles for (33kV) • 11m HT Wood Poles for (11kV) • 9m LV Wood Poles(0.433kV)
2	Conductors	Conductor Size & Length (in Km)	• LV - 4x120AAC • LV - 4x50AAC • HT - 3x120AAC
3	Substation Equipment & Accessories	• 50kVA • 100kVA • 200kVA • 315kVA • 500kVA • 500kVA (Partial Package) • 500kVA (Full Package) • 800kVA • 800kVA (Partial Package) • 800kVA (Full Package)	• 11/0.433KV PMT • 33/0.433KV PMT

A screen shot of the user interface for power distribution sector unit cost estimator is shown in figure 6-1 with the cost drivers and the window where the unit cost output is presented.

Figure 6-1: User Interface of the Power Distribution Unit Cost Estimator



Public Procurement Authority
Improving efficiency and transparency in Public Procurement

Power Sector
UCOI Estimator
Budget Tool

Input Required
Output

Power Infrastructure Unit Cost Estimator | Type of Power Project: **Distribution**

Cost Drivers	Select Options for Project		
POLES			
Wood Poles & Accessories (No)	11m HT Wood Poles for (11kV)	11m HT Wood Poles for (33kV)	9m LV Wood Poles(0.433kV)
Intermediate Pole (IP)	0	0	0
Light Angle Pole (LA)	0	0	0
Section Pole (SP)	0	0	0
T-OFF	0	0	0
Heavy Angle (HA)	0	0	0
Terminal Pole (TP)	0	0	0
CONDUCTORS			
	LV - 4x120AAC	LV - 4x50AAC	HT - 3x120AAC
Conductor Size & Length (Km)	0	0	0

SUBSTATION EQUIPMENT & ACCESSORIES (No)	11/0.433KV PMT	33/0.433KV PMT
50kVA	0	0
100kVA	0	0
200kVA	0	0
315kVA	0	0
500kVA	0	
500kVA (Partial Package)	0	
500kVA (Full Package)	0	
800kVA	0	
800kVA (Partial Package)	0	
800kVA (Full Package)	0	

Total Infrastructure Cost (USD)	-
Contingency (USD)	-
Grand Total USD (0.433kV LV Distribution Network)	-

6.1.2. Power-Distribution Budget Tool

The power distribution budget tool allows the user to include the cost of other factors that relate to the development of a power distribution project. The budget tool developed here was also based on the experience of power sector experts as well as based on interactions with the key stakeholders in the sector in Ghana.

The identified elements of the power distribution budget tool include budget allocation for:

- Project Formulation/Preparation;
- Pre-Feasibility Studies (Financial Arrangements & Consultant Procurement);
- Feasibility Studies (Project Planning & Preliminary Design);
- Detailed Design;
- Contract Administration (Including Stakeholder engagement and social enquiry);
- Project Implementation Agency Management and Monitoring;
- Post Contract Follow-up activities by Implementing Agency; and
- Provision for Others.

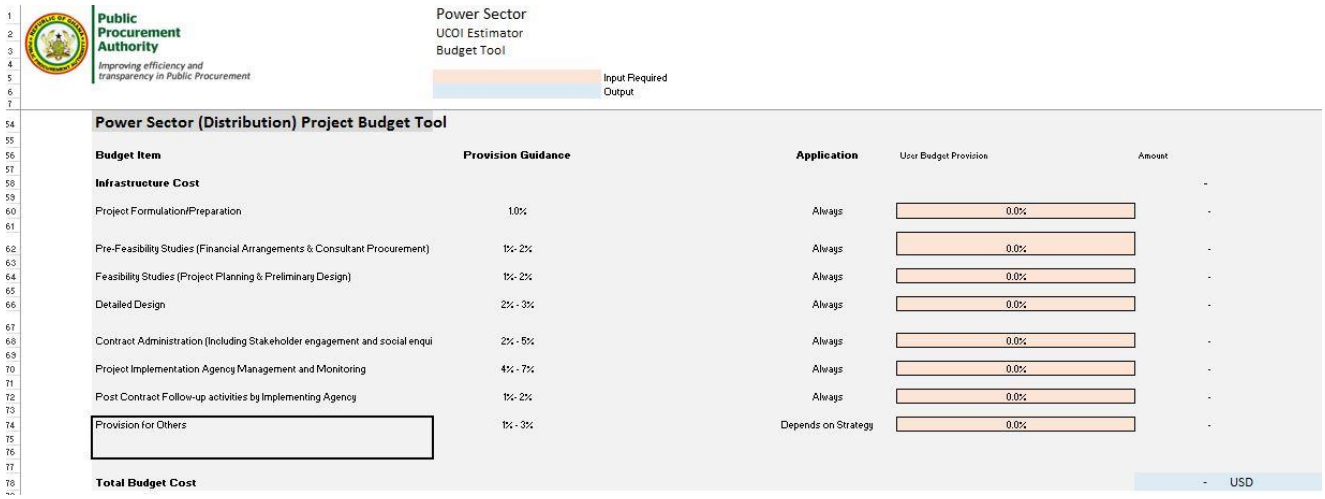
Provision was made as a guide to what proportion of the initial infrastructure cost should be allocated to the above items. These options can be seen under the **'Provision Guidance'** header. This enables the user to apply some informed basis to selecting an appropriate percentage where his or her input is required under the **'User Budget Provision'**. Here, the user can enter a percentage value for any of the applicable items provided.

The budget tool for the power distribution sector also allows the user to enter any additional items that may not fall within the items above set within the project budget tool for the sector. These include items such as:

- Land acquisition; and
- Environmental and Social Impact Assessment etc.

Below is a screenshot of the power distribution budget tool.

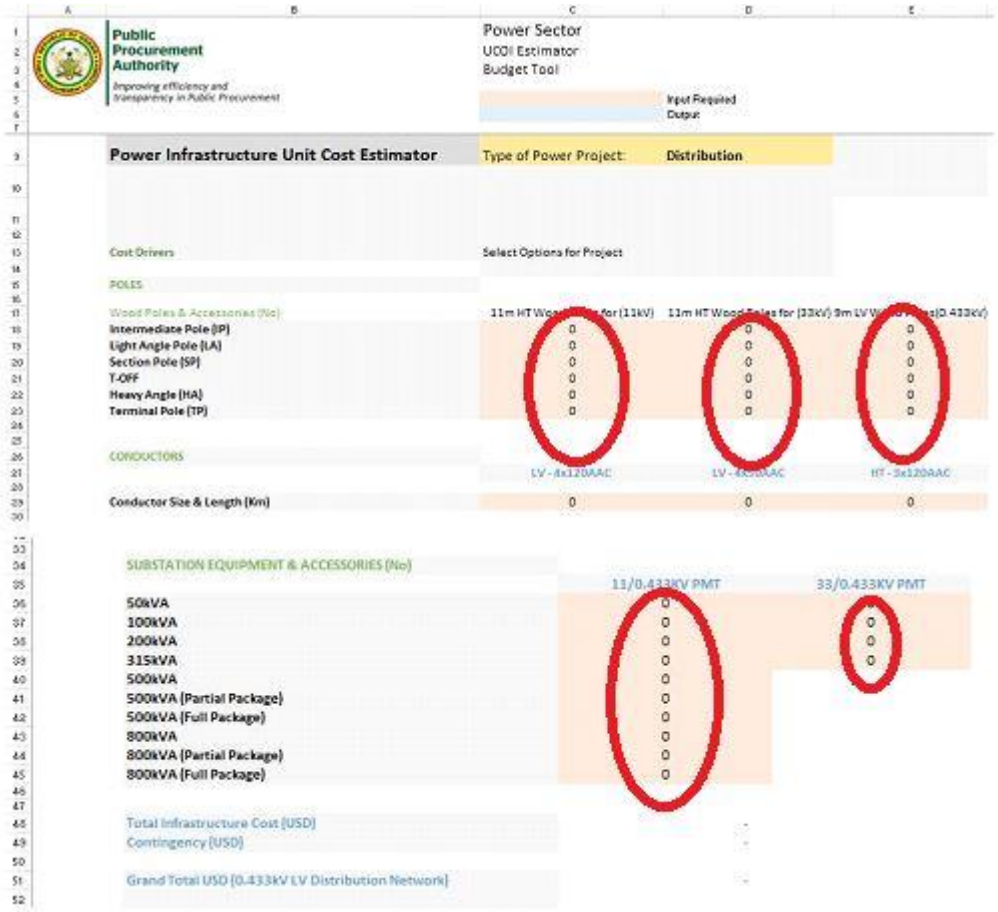
Figure 6-2: User Interface of the Power Distribution Budget Tool



6.2. How to use the Power-Distribution Unit Cost Estimator

Essentially, the power distribution unit cost estimator only requires users to make inputs or entries for the applicable cost drivers and components for their project. The input sections of the power distribution unit cost estimator are highlighted in the figure below.

Figure 6-3: User Input Sections -Power Sector Distribution Unit Cost Estimator



Once the user enters the various values for each of the corresponding cost drivers, the power distribution unit cost estimator reports a unit cost estimate i.e. '**Total Infrastructure Cost'**, **'Contingency'** value and a **'Grand Total'** based on the entries made**.** Depending on the values entered in the input sections, the unit cost of the power distribution project will change as well as the Contingency and Grand Total values (See Figure 6-4).

Figure 6-4: Power Distribution Unit Cost and Cost Estimate Output

	SUBSTATION EQUIPMENT & ACCESSORIES (No)	11/0.433KV PMT	33/0.433KV PMT
36	50kVA	1	1
37	100kVA	1	1
38	200kVA	1	1
39	315kVA	1	1
40	500kVA	1	
41	500kVA (Partial Package)	1	
42	500kVA (Full Package)	1	
43	800kVA	1	
44	800kVA (Partial Package)	1	
45	800kVA (Full Package)	1	
46			
47			
48	Total Infrastructure Cost (USD)		
49	Contingency (USD)		
50			
51	Grand Total USD (0.433kV LV Distribution Network)		
52			

6.2.1. Summary of Steps-Power-Distribution Unit Cost Estimator

1. Enter the applicable value or number in the input required sections for the 11/0.433KV PMT or the 33/0.433KV PMT; and
2. The total infrastructure cost in USD will be produced as well as the Grand Total (0.433kV LV Distribution Network) that will be incurred for establishing the water infrastructure with the user provided information.

Key Points to note on the use of the Power Distribution Unit Cost Estimator

- It is recommended that the tool should be used by a technical person who understands and can interpret the content. All results and interpretations are the sole responsibility of the user;
- The contract cost data used comprise solely of project costs for various power distribution infrastructure projects at the **award prices**. It therefore expresses how much it would cost to distribute power without consideration of any variations, extensions of time or any other changes to the original contract awarded;
- Output of unit cost estimator for power distribution feeds into the budget tool. The power distribution infrastructure cost and budget tool estimate are expressed in **USD**; and
- To avoid errors, it is suggested that the user only inputs absolute values i.e. 1, 2, 3 etc. for the various components in the applicable areas.

6.3. How to use the Power-Distribution Budget Tool

The cost estimate derived from the unit cost estimator feeds into the budget tool as the **'Total Infrastructure Cost'.** Users are only required to provide input in the form of percentages for the 8 budget line items as highlighted in Figure 6-5 at the **'User Budget Provision'** column of the tool. As mentioned earlier, the **'Provision guidance'** provided should enable the user to apply some informed basis to select an appropriate percentage required under the **'User Budget Provision.**

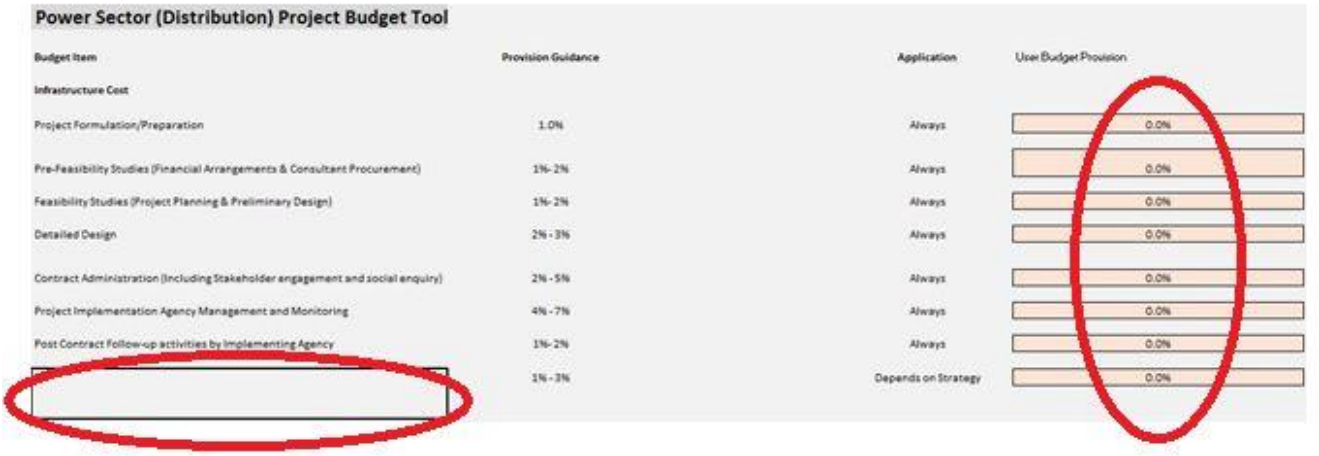
The budget line items for which users would provide the input include:

- Project Formulation/Preparation;
- Pre-Feasibility Studies (Financial Arrangements & Consultant Procurement);
- Feasibility Studies (Project Planning & Preliminary Design);
- Detailed Design;
- Contract Administration (Including Stakeholder engagement and social enquiry);
- Project Implementation Agency Management and Monitoring;
- Post Contract Follow-up activities by Implementing Agency; and
- Provision for Others.

The budget tool as mentioned earlier also allows the user to enter any additional items that may not fall within the items above set within the project budget tool for the sector. These include items such as:

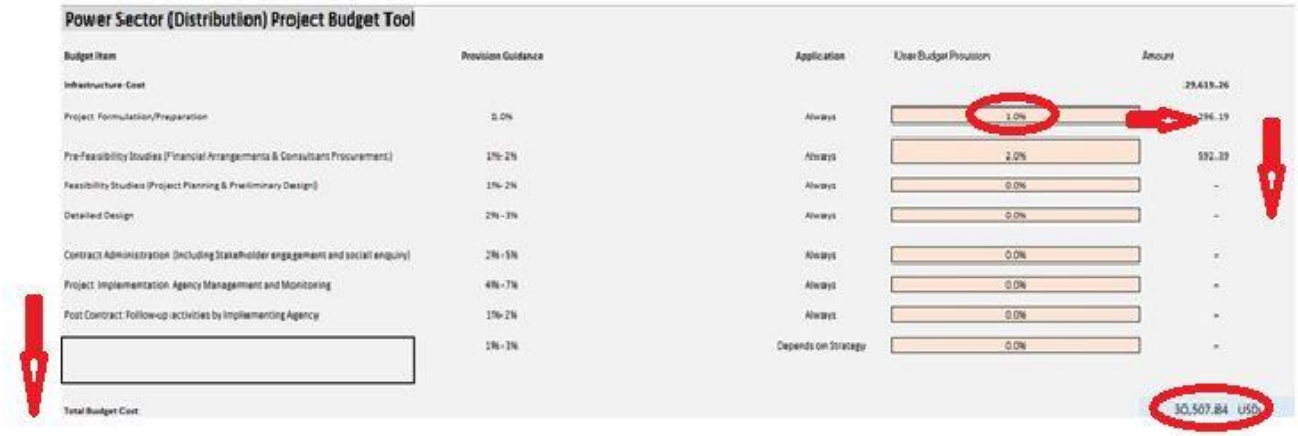
- Land acquisition; and
- Environmental and Social Impact Assessment etc.

Figure 6-5: User Input Section – Power Distribution Budget Tool



Once the user inputs the budget provision percentages for each of the corresponding budget line items, the power distribution budget tool will report a budget estimate i.e. '**Total Budget Cost'.** The total budget cost will be derived from the outcomes of the budget line items calculated as percentages of the Infrastructure Cost and added to the infrastructure cost amount obtained from the unit cost estimator (See Figure 6-6)

Figure 6-6: Power Distribution Total Budget Cost Output



Key Points to note on the use of the Power Distribution Budget Tool

- The output of the unit cost estimator for the power distribution feeds into the budget tool. The power distribution unit cost and budget tool estimate are expressed in **USD**;
- To avoid errors, it is suggested that the user only inputs the absolute values i.e. 1, 2, 3 etc. for the various components in the applicable areas; and
- It is also recommended that users consider the provision guidance in making their input. It is worth noting that these guidelines were derived based on expert experience as well as from interactions with key stakeholders within the sector.

6.4. User Interface- Power Transmission 161kV

The unit cost estimator for power transmission was also developed using the Component Cost modelling approach. The main cost drivers identified from the analysis of the power transmission are shown in the following table.

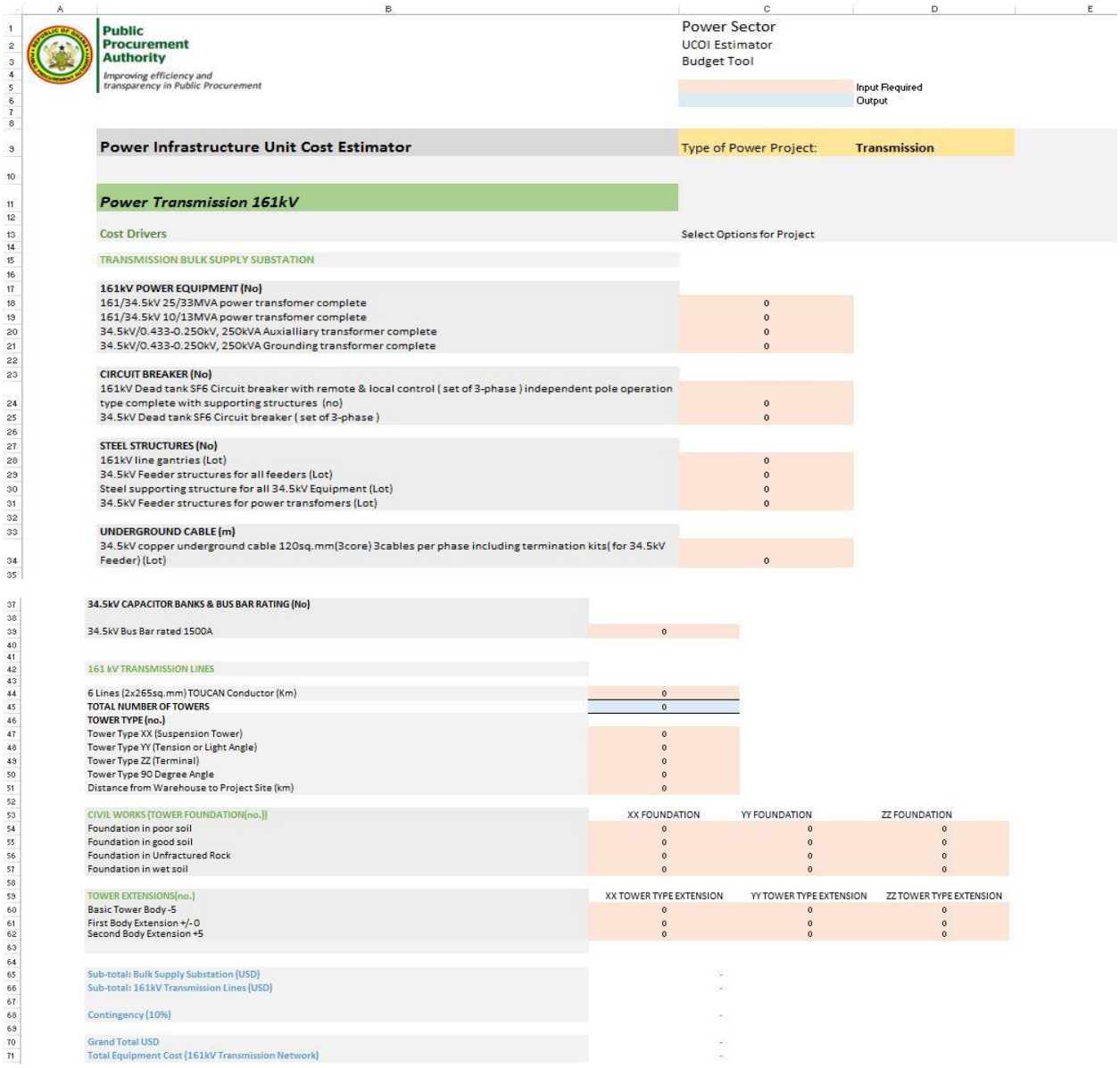
Table 6-2: Power Transmission Unit Cost Drivers (Components)

No.	Cost Driver	Main Component	Sub-Components
1	Transmission Bulk Supply Substation	161kV Power Equipment	• 161/34.5kV 25/33MVA power transformer complete • 161/34.5kV 10/13MVA power transformer complete • 34.5kV/0.433-0.250kV, 250kVA Auxiliary transformer complete • 34.5kV/0.433-0.250kV, 250kVA Grounding transformer complete
		Circuit Breaker	• 161kV Dead tank SF6 Circuit breaker with remote & local control (set of 3-phase) independent pole operation type complete with supporting structures (no) • 34.5kV Dead tank SF6 Circuit breaker (set of 3-phase)
		Steel Structures	• 161kV line gantries (Lot) • 34.5kV Feeder structures for all feeders (Lot) • Steel supporting structure for all 34.5kV Equipment (Lot) • 34.5kV Feeder structures for power transformers (Lot)
		Underground Cable	34.5kV copper underground cable 120sq.mm(3core) 3cables per phase including termination kits(for 34.5kV Feeder) (Lot)
		34.5kV Capacitor Banks & Bus Bar Rating	34.5kV Bus Bar rated 1500A
2	161 kV Transmission Lines	2x265sq.mm TOUCAN Conductor (Km)	
		Tower Type (no.)	• Tower Type XX • Tower Type YY • Tower Type ZZ • Tower Type 90 Degree Angle • Distance from Warehouse to Project Site (km)
3	Civil Works (Tower Foundation(no.))	• Foundation in poor soil • Foundation in good soil • Foundation in Unfractured Rock • Foundation in wet soil	• XX Foundation • YY Foundation • ZZ Foundation
4	Tower Extensions	Basic Tower Body -5:	• XX Tower Type Extension • YY Tower Type Extension • ZZ Tower Type Extension
		First Body Extension +/- 0:	• XX Tower Type Extension • YY Tower Type Extension

No.	Cost Driver	Main Component	Sub-Components
			• ZZ Tower Type Extension
		Second Body Extension +5:	• XX Tower Type Extension • YY Tower Type Extension • ZZ Tower Type Extension

Screen shots of the user interface for power transmission unit cost estimator are shown in figure 6-7 with the cost drivers and the window where the unit cost output is presented.

Figure 6-7: User Interface of the Power Transmission Unit Cost Estimator



6.4.1. Power Transmission Budget Tool

The power transmission budget tool allows the user to include the cost of other factors that relate to the development of a power transmission project. For the purposes of the budget tool, the factors put together under this project were based on the experience of power sector experts as well as based on interactions with the key stakeholders in the sector in Ghana.

The identified elements of the power transmission sector budget tool include budget allocation for:

- Project Formulation/Preparation;
- Pre-Feasibility Studies (Financial Arrangements & Consultant Procurement);
- Feasibility Studies (Project Planning & Preliminary Design);
- Detailed Design;
- Preliminaries (Site Preparation, Boundary Works, Sub-Station yard surfacing);
- Contract Administration (Including Stakeholder engagement and social enquiry);
- Project Implementation Agency Management and Monitoring;
- Post Contract Follow-up activities by Implementing Agency; and
- Provision for Others.

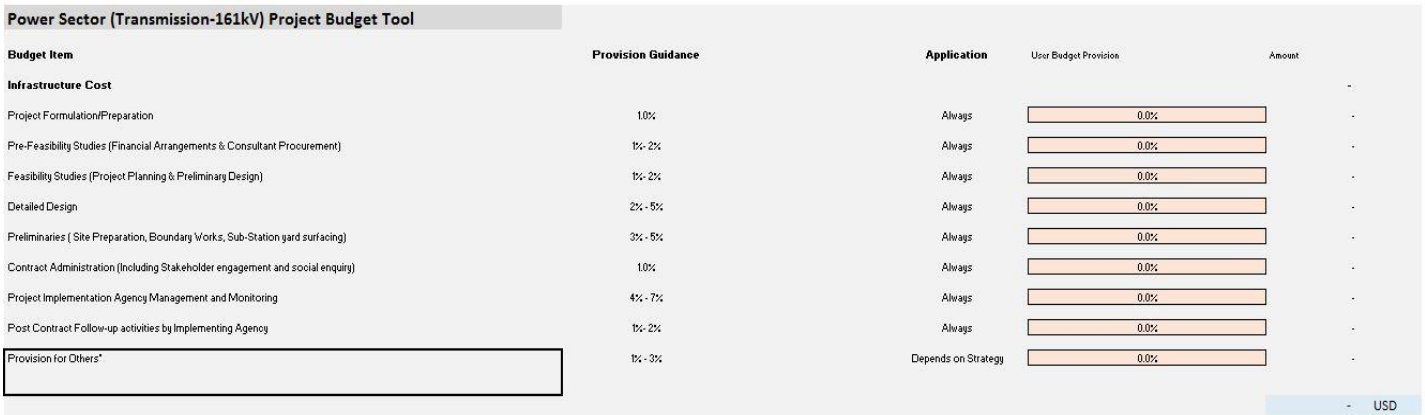
Provision was made as guide to what proportion of the initial infrastructure cost should be allocated to the above items. These options can be seen under the **'Provision Guidance'** header. This enables the user to apply some informed basis to selecting an appropriate percentage where his or her input is required under the **'User Budget Provision'**. Here, the user can enter a percentage value for any of the applicable items provided.

The budget tool for power transmission also allows the user to enter any additional items that may not fall within the items above set within the project budget tool for the sector. These include items such as:

- Land acquisition; and
- Environmental and Social Impact Assessment etc.

Below is a screenshot of the power transmission budget tool.

Figure 6-8: User Interface of the Power Transmission Budget Tool



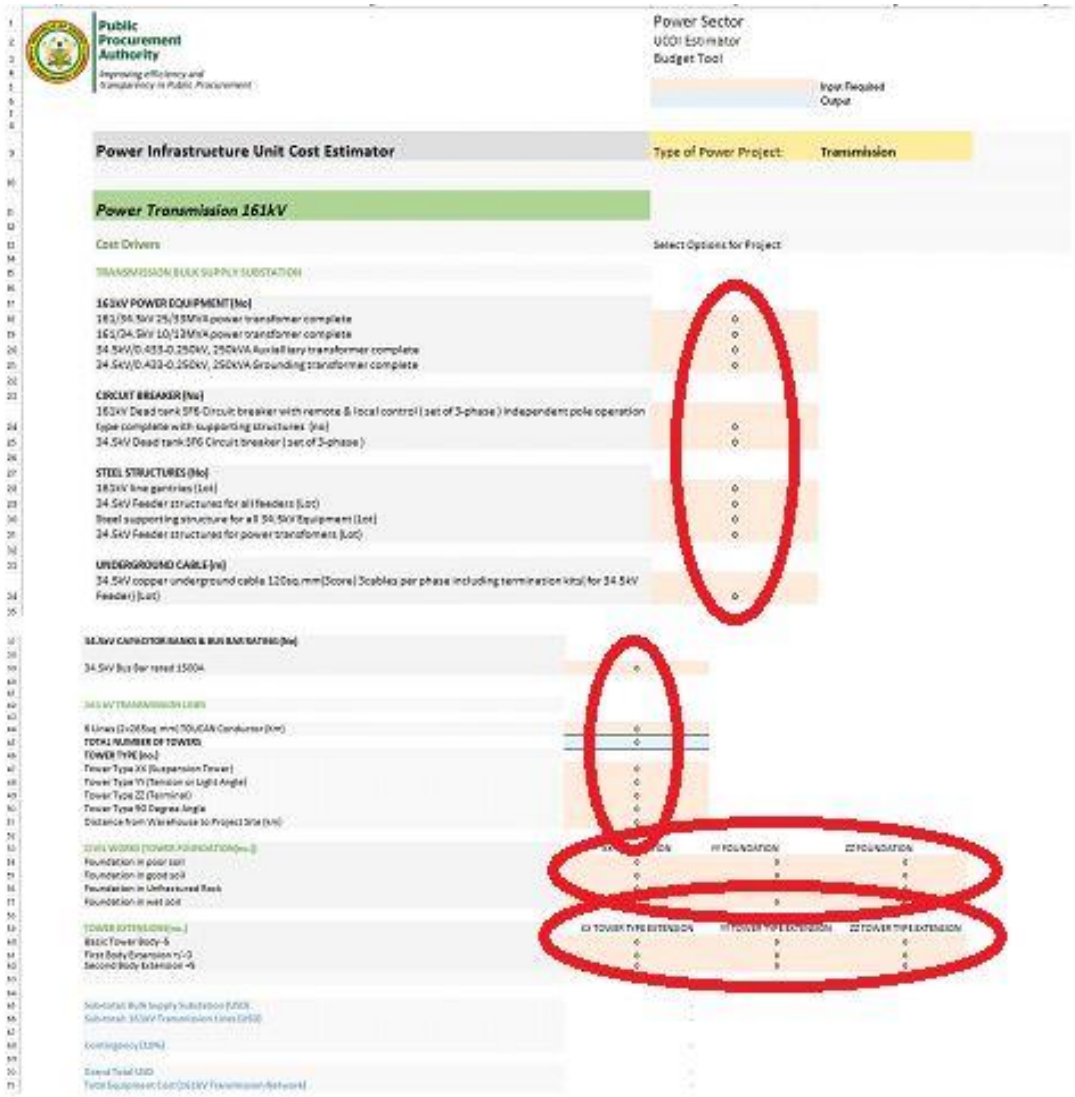
Power Sector (Transmission-161kV) Project Budget Tool

Budget Item	Provision Guidance	Application	User Budget Provision	Amount
Infrastructure Cost				-
Project Formulation/Preparation	1.0%	Always	0.0%	-
Pre-Feasibility Studies (Financial Arrangements & Consultant Procurement)	1% - 2%	Always	0.0%	-
Feasibility Studies (Project Planning & Preliminary Design)	1% - 2%	Always	0.0%	-
Detailed Design	2% - 5%	Always	0.0%	-
Preliminaries (Site Preparation, Boundary Works, Sub-Station yard surfacing)	3% - 5%	Always	0.0%	-
Contract Administration (Including Stakeholder engagement and social enquiry)	1.0%	Always	0.0%	-
Project Implementation Agency Management and Monitoring	4% - 7%	Always	0.0%	-
Post Contract Follow-up activities by Implementing Agency	1% - 2%	Always	0.0%	-
Provision for Others*	1% - 3%	Depends on Strategy	0.0%	-
				- USD

6.5. How to use the Power Transmission Unit Cost Estimator

The power transmission unit cost estimator only requires users to make inputs or entries for the applicable cost drivers and components for their project. The input sections of the power distribution unit cost estimator are highlighted in the figure below.

Figure 6-9: User Input Sections -Power Transmission Unit Cost Estimator



Once the user enters the various values for each of the corresponding cost drivers, the power sector distribution unit cost tool will report results for the following based on the entries made:

- Sub-total: Bulk Supply Substation (USD);
- Sub-total: 161kV Transmission Lines (GHS);
- Contingency (10%);
- Grand Total USD; and
- Total Equipment Cost (161kV Transmission Network).

This is shown in Figure 6-10 as follows.

Figure 6-10: Power Transmission Unit Cost and Cost Estimate Output

6.5.1. Summary of Steps-Power Transmission Unit Cost Estimator

- Enter the applicable value or number in the input required sections; and
- Results for the following will be generated:
  - Sub-total: Bulk Supply Substation (USD);
  - Sub-total: 161kV Transmission Lines (GHS);
  - Contingency (10%);
  - Grand Total USD; and
  - Total Equipment Cost (161kV Transmission Network).

Key Points to note on the use of the Power Transmission Unit Cost Estimator

- It is recommended that the tool should be used by a technical person who understands and can interpret the content. All results and interpretations are the sole responsibility of the user;
- The contract cost data used comprise solely of project costs for power transmission infrastructure projects at the **award prices**. It therefore expresses how much it would cost to transmit 161 kV power without consideration of any variations, extensions of time or any other changes to the original contract awarded;
- The output of the unit cost estimator for power transmission feeds into the budget tool. The power transmission infrastructure cost and budget tool estimate are expressed in **USD**; and
- To avoid errors, it is suggested that the user only inputs absolute values i.e. 1, 2, 3 etc. for the various components in the applicable areas.

6.6. How to use the Power Transmission Budget Tool

The cost estimate derived from the unit cost estimator i.e. Grand Total (USD) feeds into the budget tool as the **'Infrastructure Cost'.** Users are only required to provide input in the form of percentages for the 9 budget line items as highlighted in Figure 6-11 at the **'User Budget Provision'** column of the tool. The **'Provision guidance'** should enable the user to apply some informed basis to select an appropriate percentage required under the **'User Budget Provision.**

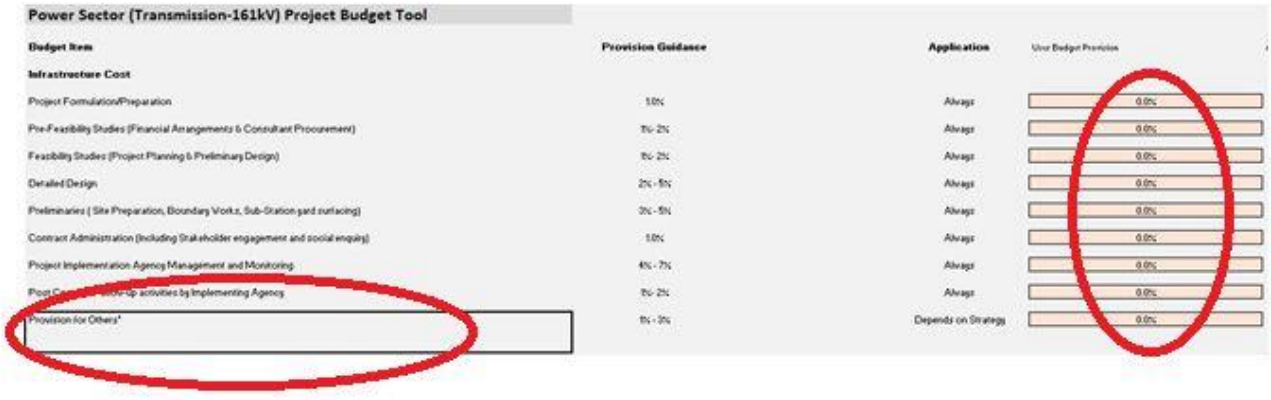
The budget line items for which users would provide the input include:

- Project Formulation/Preparation;
- Pre-Feasibility Studies (Financial Arrangements & Consultant Procurement);
- Feasibility Studies (Project Planning & Preliminary Design);
- Detailed Design;
- Preliminaries (Site Preparation, Boundary Works, Sub-Station yard surfacing);
- Contract Administration (Including Stakeholder engagement and social enquiry);
- Project Implementation Agency Management and Monitoring;
- Post Contract Follow-up activities by Implementing Agency; and
- Provision for Others.

The budget tool as mentioned earlier also allows the user to enter any additional items that may not fall within the items above set within the project budget tool for the sector. These include items such as:

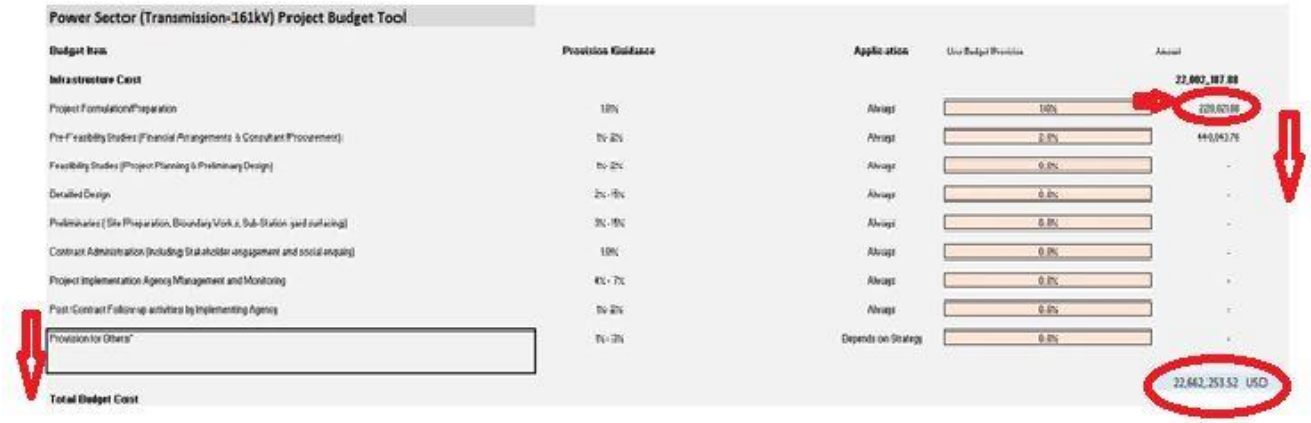
- Land acquisition; and
- Environmental and Social Impact Assessment etc.

Figure 6-11: User Input Section – Power Transmission Budget Tool



Once the user inputs the budget provision percentages for each of the corresponding budget line items, the power transmission budget tool will report a budget estimate i.e. '**Total Budget Cost'.** The total budget cost will be derived from the outcomes of the budget line items calculated as percentages of the Infrastructure Cost and added to the initial infrastructure cost amount obtained from the unit cost estimator (See Figure 6-12)

Figure 6-12: Power Transmission Total Budget Cost Output



Key Points to note on the use of the Power Transmission Budget Tool

- The output of the unit cost estimator for power transmission feeds into the budget tool. The power transmission unit cost and budget tool estimate are expressed in **USD**;
- To avoid errors, it is suggested that the user only inputs the absolute values i.e. 1, 2, 3 etc. for the various components in the applicable areas; and
- It is also recommended that users consider the provision guidance in making their input. It is worth noting that these guidelines were derived based on expert experience as well as from interactions with key stakeholders within the sector.

6.7. User Interface- Power Sub-Transmission 33kV

The unit cost estimator for power sub-transmission was also developed using the Component Cost modelling approach. The main cost drivers identified from the analysis of power sub-transmission are shown in the following table.

Table 6-3: Power Sub-Transmission Unit Cost Drivers (Components)

No.	Cost Driver	Main Component	Sub-Components
1	Sub-Transmission Bulk Supply Point	33kV Indoor 3000A Double Busbar Switchgear - GIS	• 33kV I/D Incomer Panel, c/w 2000A CB, VTs & 1000/2000/5/5/5A • 33kV I/D Feeder Panel, c/w 1250A CB, VTs & 600/1200/5/5A • 33kV Auxiliary Transformer Cubicle equipped with Fuse/Switch • 33kV 3000A Busbar Sectionaliser Panel
		11kV Indoor Switchgear - 2000A Busbar Rating- GIS	• 11kV I/D Feeder Cubicle C/W 630A CB, Overcurrent and Earthfault Relays, Metering CTs, Reclosing Relays and Sensitive Earthfault Relays, Earth Switch, Instanteneous and Max. Demand Ammeter, KWhr and KVAhr Meter • 11kV I/D Bus Coupler C/W 2000A CB, Protection and Metering CTs and Relays • 11kV Auxiliary transformer Cubicle equipped with Fuse/Switch
		Power Transformer, OLTC Panel & NGRs	• 30/39 MVA ONAN/ONAF 33/11KV Power Transformer • 11kV Neutral Earth Resistor, Isolator & 800/5A Current Transformer
		100kVA, 400/230V 50Hz Standby Generator	• 100kVA, 400/230V 50Hz Standby Generator c/w Manual changeover between the two (2) station service transformers and the Generator (no.) • 200kVA Auxiliary Transformer 33kV/400V/230V (no.) • LV AC Distribution Board (no.)
		Provision of Scada Facility	Central Event Monitoring and Evaluation system, Remote Terminal Unit (RTU) Micom C264 Complete with radio and wire all SCADA alarm and signal command points in individual control panels to RTU (Complete with all accessories to make functional)
		Civil Works & Earth Grid	• 50 Sq. mm. Copper Earth Grid for land area Xm by Xm • All relevant civil works associated with the substation work (Lot)

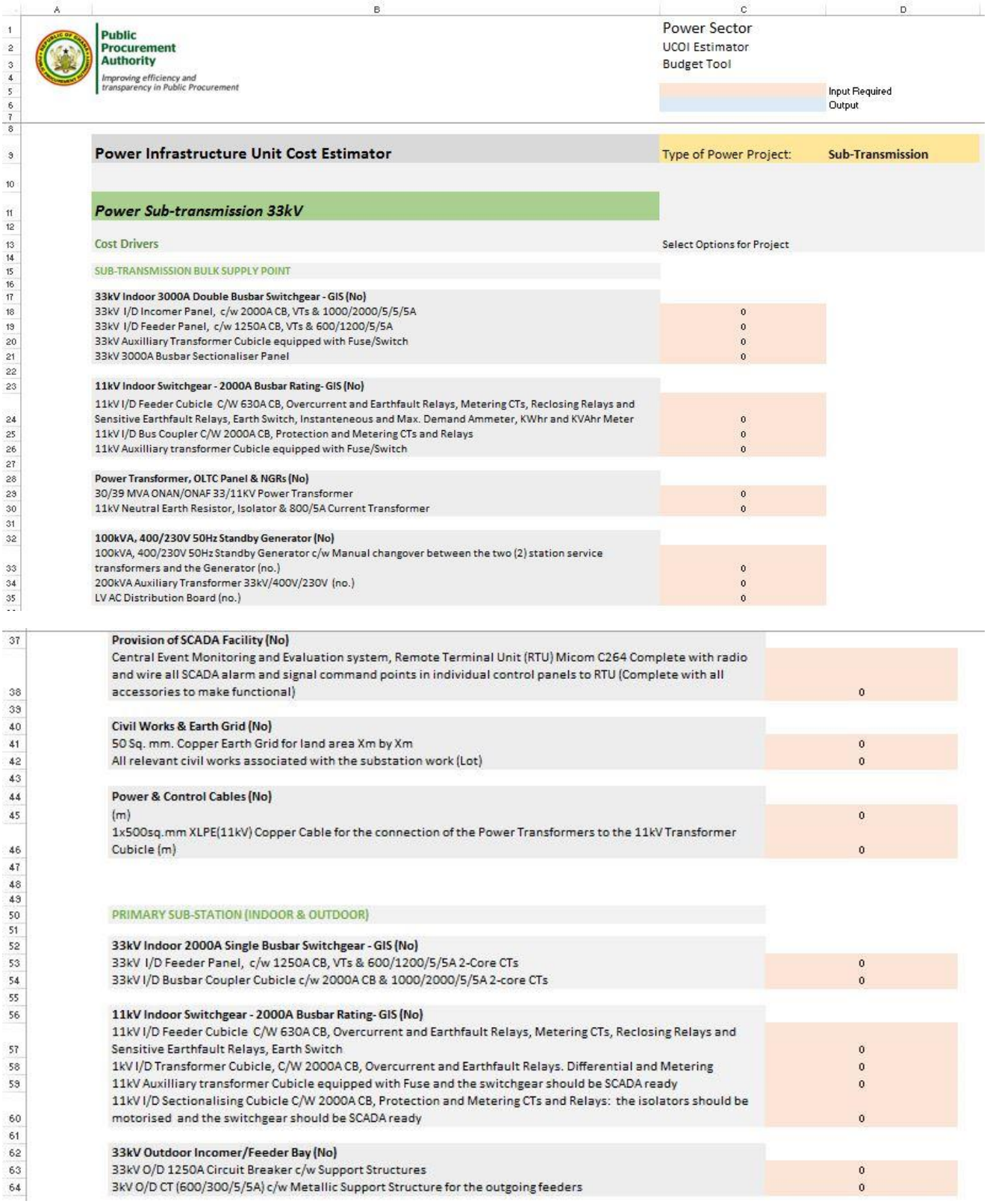
No.	Cost Driver	Main Component	Sub-Components
		Power & Control Cables	• 1x500sq.mm XLPE(33kV) Copper Cable for the connection of GRIDCo Transformers to the 33kV Incomer Cubicle (m) • 1x500sq.mm XLPE(11kV) Copper Cable for the connection of the Power Transformers to the 11kV Transformer Cubicle (m)
2	Primary Sub-Station (Indoor & Outdoor)	33kV Indoor 2000A Single Busbar Switchgear - GIS	• 33kV I/D Feeder Panel, c/w 1250A CB, VTs & 600/1200/5/5A 2-Core CTs • 33kV I/D Busbar Coupler Cubicle c/w 2000A CB & 1000/2000/5/5A 2-core CTs
		11kV Indoor Switchgear - 2000A Busbar Rating- GIS	• 11kV I/D Feeder Cubicle C/W 630A CB, Overcurrent and Earthfault Relays, Metering CTs, Reclosing Relays and Sensitive Earthfault Relays, Earth Switch • 1kV I/D Transformer Cubicle, C/W 2000A CB, Overcurrent and Earthfault Relays. Differential and Metering • 11kV Auxiliary transformer Cubicle equipped with Fuse and the switchgear should be SCADA ready • 11kV I/D Sectionalising Cubicle C/W 2000A CB, Protection and Metering CTs and Relays: the isolators should be motorised and the switchgear should be SCADA ready
		33kV Outdoor Incomer/Feeder Bay	• 33kV O/D 1250A Circuit Breaker c/w Support Structures • 3kV O/D CT (600/300/5/5A) c/w Metallic Support Structure for the outgoing feeders
		33kV Outdoor Transformer Bay	33kV O/D 1250A Circuit Breaker c/w Support Structures
		Power Transformer, OLTC Panel & NGRs	• 20/26 MVA ONAN/ONAF 33/11kV Power Transformer with indoor busings • 10/13 MVA ONAN/ONAF 33/11kV Power Transformer with indoor busings • 5MVA ONAN/ONAF 33/11kV Power Transformer with indoor busings • 2.5MVA ONAN/ONAF 33/11kV Power Transformer with indoor busings
		Auxiliary Power Supply Equipment (DC &AC)	100kVA Auxiliary Transformer 11kV/400V/220V for indoor stations

No.	Cost Driver	Main Component	Sub-Components
		Power & Control Cables	• 1x500sq.mm XLPE(33kV) Copper Cable for the connection of the Power Transformers to the 33kV Transformer Cubicle (1 run/phase) • 1x300sq.mm XLPE(11kV) Copper Cable for the connection of the Power Transformers to the 11kV Transformer Cubicle (3 runs/phase) (m) • 4 x 95sq.mm XLPE (LV) Al Cable for connection between auxiliary transformer and LV AC Distribution Board (m)
		Civil Works & Earth Grid	• 150 Sq. mm. Copper Earth Grid for Xm by Xm • Foundation of lighting structure or lightning mast (no)
3	Tower Construction	Distance	• Distance from Warehouse to Project Site (km) • Rocky Excavation (Number)
		Tower Lines (Distance covered in kilometers)	• Tower Type SS • Tower Type AC • Tower Type DE • Tower Type 90 degree angle
		Civil Works (Tower Foundation): • SS Double (400sq.mm AAC) • AC Double (400sq.mm AAC) • 90 Degree Angle • DE Double (400sq.mm AAC)	• Poor/wet Soil • Submerged
4	33kV Network Underground	Route Details (in metres): *Feeder 1*	• Road (Asphalt (R(A)) • Road (Butimen) • Road (pavement) • Road (normal ground) R(NG) • Pavement (P) • Concrete {C} • Entrances (pavement) • Entrances (normal ground) E(NG) • Entrances (concrete) E{C} • Entrances (Bitumen) • Entrances (Tiles) • Grassed Surfaces • Tiled Surfaces • Normal Ground (NG) • Number of Underground Circuits in same trench (of 3 cables per cct) • 4-inch thrust boring (m) • 6-inch thrust boring (m) • Number of thrust boring locations • Excavation and reinstatement in rocky ground (m) • Number of Indoor Termination for 1 x 630sq.mm XLPE

No.	Cost Driver	Main Component	Sub-Components
			• Number of Outdoor Termination for 1 x 630sq.mm XLPE • Number of joint • Cable Truss (m)
5	11kV Network Underground	No Of UG Circuits to be created	• Double circuit trench (11kV) • Single circuit trench (11kV)
		Underground Cable Portion: *Feeder 1*	• LENGTH (m): 1X240Al • LENGTH (m): 3X185Al • Number of Underground Circuits in same trench • 4-inch thrust boring (m) • 6-inch thrust boring (m) • Number of thrust boring locations • Pavement Block Surfaces (m) • Concrete Surfaces (m) • Grassed Surfaces (m) • Number of entrances to cross • Number of joints for 1x240mm2Al • Number of joints for 3x185mm2Al • Number of EOS per set • Number of EFS per set • Cable Truss (m) • Number of Outdoor Terminations for 1x240mm2Al • Number of Indoor Terminations for 1x240mm2Al • Number of Outdoor Terminations for 3 x 185mm2 Al • Number of Indoor Terminations for 3x185mm2Al

Screen shots of the user interface for power transmission sector unit cost estimator are shown in figure 6-13 with the cost drivers and the window where the unit cost output is presented.

Figure 6-13: User Interface of the Power Sub-Transmission Unit Cost Estimator



Public Procurement Authority
Improving efficiency and transparency in Public Procurement

Power Sector
UCOI Estimator
Budget Tool

Input Required
Output

Power Infrastructure Unit Cost Estimator | Type of Power Project: | **Sub-Transmission**

Power Sub-transmission 33kV

Cost Drivers	Select Options for Project
SUB-TRANSMISSION BULK SUPPLY POINT	
33kV Indoor 3000A Double Busbar Switchgear - GIS (No)	
33kV I/D Incomer Panel, c/w 2000A CB, VTs & 1000/2000/5/5/5A	0
33kV I/D Feeder Panel, c/w 1250A CB, VTs & 600/1200/5/5A	0
33kV Auxilliary Transformer Cubicle equipped with Fuse/Switch	0
33kV 3000A Busbar Sectionaliser Panel	0
11kV Indoor Switchgear - 2000A Busbar Rating- GIS (No)	
11kV I/D Feeder Cubicle C/W 630A CB, Overcurrent and Earthfault Relays, Metering CTs, Reclosing Relays and Sensitive Earthfault Relays, Earth Switch, Instanteneous and Max. Demand Ammeter, KWhr and KVAhr Meter	0
11kV I/D Bus Coupler C/W 2000A CB, Protection and Metering CTs and Relays	0
11kV Auxilliary transformer Cubicle equipped with Fuse/Switch	0
Power Transformer, OLTC Panel & NGRs (No)	
30/39 MVA ONAN/ONAF 33/11KV Power Transformer	0
11kV Neutral Earth Resistor, Isolator & 800/5A Current Transformer	0
100kVA, 400/230V 50Hz Standby Generator (No)	
100kVA, 400/230V 50Hz Standby Generator c/w Manual changover between the two (2) station service transformers and the Generator (no.)	0
200kVA Auxiliary Transformer 33kV/400V/230V (no.)	0
LV AC Distribution Board (no.)	0
Provision of SCADA Facility (No)	
Central Event Monitoring and Evaluation system, Remote Terminal Unit (RTU) Micom C264 Complete with radio and wire all SCADA alarm and signal command points in individual control panels to RTU (Complete with all accessories to make functional)	0
Civil Works & Earth Grid (No)	
50 Sq. mm. Copper Earth Grid for land area Xm by Xm	0
All relevant civil works associated with the substation work (Lot)	0
Power & Control Cables (No)	
(m)	0
1x500sq.mm XLPE(11kV) Copper Cable for the connection of the Power Transformers to the 11kV Transformer Cubicle (m)	0
PRIMARY SUB-STATION (INDOOR & OUTDOOR)	
33kV Indoor 2000A Single Busbar Switchgear - GIS (No)	
33kV I/D Feeder Panel, c/w 1250A CB, VTs & 600/1200/5/5A 2-Core CTs	0
33kV I/D Busbar Coupler Cubicle c/w 2000A CB & 1000/2000/5/5A 2-core CTs	0
11kV Indoor Switchgear - 2000A Busbar Rating- GIS (No)	
11kV I/D Feeder Cubicle C/W 630A CB, Overcurrent and Earthfault Relays, Metering CTs, Reclosing Relays and Sensitive Earthfault Relays, Earth Switch	0
1kV I/D Transformer Cubicle, C/W 2000A CB, Overcurrent and Earthfault Relays. Differential and Metering	0
11kV Auxilliary transformer Cubicle equipped with Fuse and the switchgear should be SCADA ready	0
11kV I/D Sectionalising Cubicle C/W 2000A CB, Protection and Metering CTs and Relays: the isolators should be motorised and the switchgear should be SCADA ready	0
33kV Outdoor Incomer/Feeder Bay (No)	
33kV O/D 1250A Circuit Breaker c/w Support Structures	0
3kV O/D CT (600/300/5/5A) c/w Metallic Support Structure for the outgoing feeders	0

33kV Outdoor Incomer/Feeder Bay (No)		
33kV O/D 1250A Circuit Breaker c/w Support Structures	0	
3kV O/D CT (600/300/5/5A) c/w Metallic Support Structure for the outgoing feeders	0	
33kV Outdoor Transformer Bay (No)		
33kV O/D 1250A Circuit Breaker c/w Support Structures	0	
Power Transformer, OLTC Panel & NGRs (No)		
20/26 MVA ONAN/ONAF 33/11kV Power Transformer with indoor busings	0	
10/13 MVA ONAN/ONAF 33/11kV Power Transformer with indoor busings	0	
5MVA ONAN/ONAF 33/11kV Power Transformer with indoor busings	0	
2.5MVA ONAN/ONAF 33/11kV Power Transformer with indoor busings	0	
Auxiliary Power Supply Equipment (DC &AC) (No)		
100kVA Auxiliary Transformer 11kV/400V/220V for indoor stations	0	
Power & Control Cables (m)		
1x500sq.mm XLPE(33kV) Copper Cable for the connection of the Power Transformers to the 33kV Transformer Cubicle (1 run/phase)	0	
1x300sq.mm XLPE(11kV) Copper Cable for the connection of the Power Transformers to the 11kV Transformer Cubicle (3 runs/phase) (m)	0	
4 x 95sq.mm XLPE (LV) Al Cable for connection between auxilliary transformer and LV AC Distribution Board (m)	0	
Civil Works & Earth Grid (m2)		
150 Sq. mm. Copper Earth Grid for Xm by Xm		
Foundation of lighting structure or lightning mast (no)	0	

TOWER CONSTRUCTION			
Distance From Warehouse.			
Distance from Warehouse to Project Site (km)	0		
Double Circuit Tower Lines (km)			
Tower Type SS (0°-3°) - 400sq.mm AAC	0		
Tower Type AC (3°- 60°) - 400sq.mm AAC	0		
Tower Type DE (30°- 60°) - 400sq.mm AAC	0		
Tower Type 90° - 400sq.mm AAC	0		
Civil Works (Tower Foundation) (No)	Poor/wet Soil	Submerged	
Tower Type SS (0°-3°)	0	0	
Tower Type AC (3°- 60°)	0	0	
Tower Type 90°	0	0	
Tower Type DE (30°- 60°)	0	0	
Rocky Excavation (Number)	0		
33kV NETWORK UNDERGROUND			
ROUTE DETAILS (in metres)	**FEEDER 1**		
Gutter (G)	0		
Gutter Cable Truss (G)	0		
Road (Asphalt (R(A))	0		
Road (Butimen)	0		
Road (pavement)	0		
Road (normal ground) R(NG)	0		
Pavement (P)	0		
Concrete {C}	0		
Entrances (pavement)	0		
Entrances (normal ground) E(NG)	0		
Entrances (concrete) E{C}	0		

Entrances (Bitumen)	0	
Entrances (Tiles)	0	
Grassed Surfaces	0	
Tiled Surfaces	0	
Normal Ground (NG)	0	
Number of Underground Circuits in same trench (of 3 cables per cct)	0	
4-inch thrust boring (m)	0	
6-inch thrust boring (m)	0	
Number of thrust boring locations	0	
Excavation and reinstatement in rocky ground (m)	0	
Number of Indoor Termination for 1 x 630sq.mm XLPE	0	
Number of Outdoor Termination for 1 x 630sq.mm XLPE	0	
Number of joint	0	
Cable Truss (m)	0	
11kV NETWORK UNDERGROUND		
UNDERGROUND (UG) CIRCUITS TO BE CREATED (No)	**NUMBER**	
Double circuit trench (11kV)	0	
Single circuit trench (11kV)	0	
UNDERGROUND CABLE PORTION	**FEEDER 1**	
LENGTH (m): 1X240Al	0	
LENGTH (m): 3X185Al	0	
Number of Underground Circuits in same trench	0	
4-inch thrust boring (m)	0	
6-inch thrust boring (m)	0	
Number of thrust boring locations	0	
Pavement Block Surfaces (m)	0	
Concrete Surfaces (m)	0	
Grassed Surfaces (m)	0	
Number of entrances to cross	0	

Number of joints for 1x240mm^{2}Al	0	
Number of joints for 3x185mm^{2}Al	0	
Number of EOS per set	0	
Number of EFS per set	0	
Cable Truss (m)	0	
Number of Outdoor Terminations for 1x240mm^{2}Al	0	
Number of Indoor Terminations for 1x240mm^{2}Al	0	
Number of Outdoor Terminations for 3 x 185mm^2 Al	0	
Number of Indoor Terminationsfor 3x185mm^{2}Al	0	

Sub-total: Bulk Supply Point	-	
Sub-total: Primary Sub-station Indoor & Outdoor	-	
Sub-total: Tower Construction	-	
Sub-total: 33kV Network Underground	-	
Sub-total: 11kV Network Underground	-	
Contingency (10%)	-	
Grand Total USD (33kV Sub-Transmission Network)	-	USD

6.7.1. Power Sub-Transmission Budget Tool

The power sub-transmission budget tool allows the user to include the cost of other factors that relate to the development of a power sub-transmission infrastructure project. The budget tool here was also developed based on the experience of power sector experts as well as based on interactions with the key stakeholders in the sector in Ghana.

The identified elements of the buildings sector project budget tool include budget allocation for:

- Project Formulation/Preparation;
- Pre-Feasibility Studies (Financial Arrangements & Consultant Procurement);
- Feasibility Studies (Project Planning & Preliminary Design);
- Preliminaries (Site Preparation, Boundary Works, Sub-Station yard surfacing);
- Detailed Design;
- Contract Administration (Including Stakeholder engagement and social enquiry);
- Project Implementation Agency Management and Monitoring;
- Post Contract Follow-up activities by Implementing Agency; and
- Provision for Others.

Provision was made as a guide to what proportion of the initial infrastructure cost should be allocated to the above items. These options can be seen under the **'Provision Guidance'** header. This enables the user to apply some informed basis to selecting an appropriate percentage where his or her input is required under the **'User Budget Provision'**. Here, the user can enter a percentage value for any of the applicable items provided.

The budget tool for the power sub-transmission sector also allows the user to enter any additional items that may not fall within the items above set within the project budget tool for the sector. These include items such as:

- Land acquisition; and
- Environmental and Social Impact Assessment etc.

Below is a screenshot of the power transmission budget tool.

Figure 6-14: User Interface of the Power Sub-Transmission Budget Tool

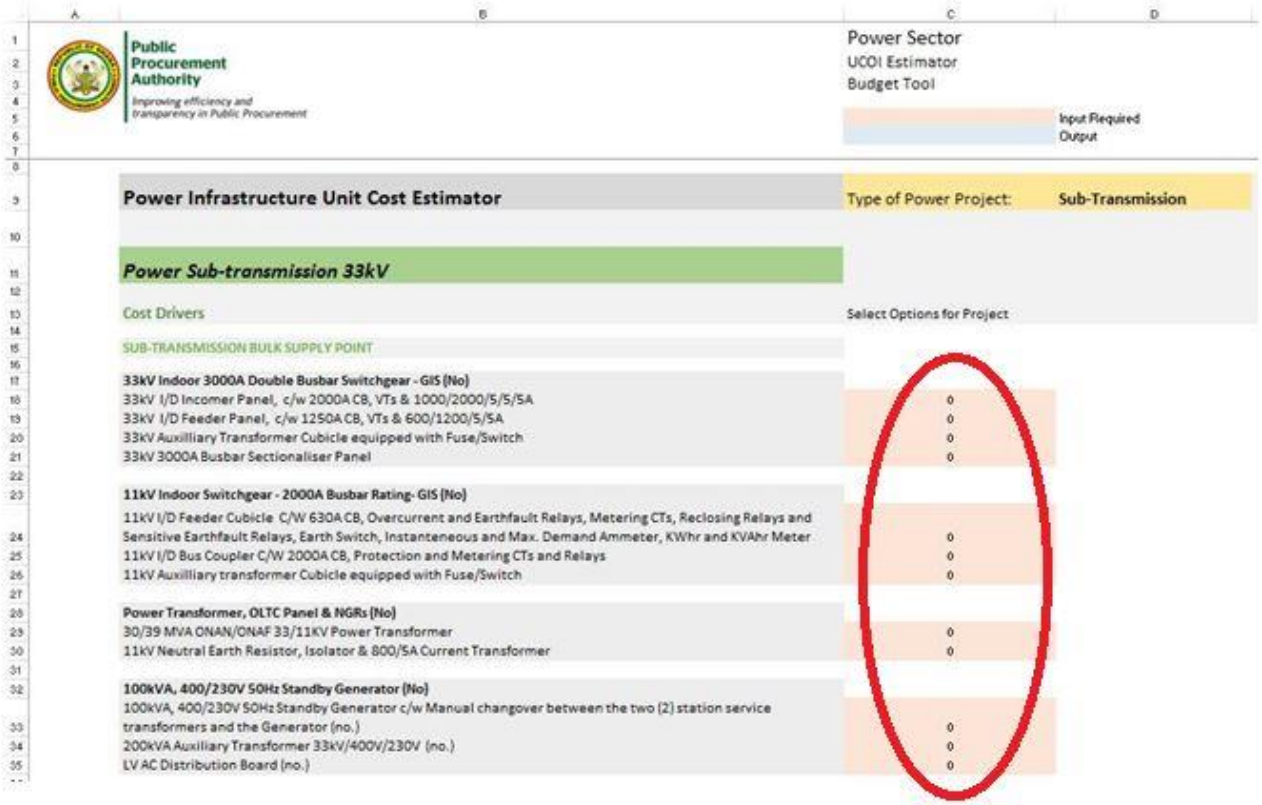
Power Sector (Sub-transmission-33kV) Project Budget Tool

Budget Item	Provision Guidance	Application	User Budget Provision	Amount
Infrastructure Cost				
Project Formulation/Preparation	1.0%	Always	0.0%	-
Pre-Feasibility Studies (Financial Arrangements & Consultant Procurement)	1% - 2%	Always	0.0%	-
Feasibility Studies (Project Planning & Preliminary Design)	1% - 2%	Always	0.0%	-
Preliminaries (Site Preparation, Boundary Works, Sub-Station yard surfacing)	2% - 5%	Always	0.0%	-
Detailed Design	3% - 5%	Always	0.0%	-
Contract Administration (Including Stakeholder engagement and social enquiry)	1.0%	Always	0.0%	-
Project Implementation Agency Management and Monitoring	4% - 7%	Always	0.0%	-
Post Contract Follow-up activities by Implementing Agency	1% - 2%	Always	0.0%	-
Provision for Others	1% - 3%	Depends on Strategy	0.0%	-
Total Budget Cost				- USD

6.8. How to use the Power Sub-Transmission Unit Cost Estimator

The power sub-transmission unit cost estimator only requires users to make inputs or entries for the applicable cost drivers and components for their project. The input sections of the power distribution unit cost estimator are highlighted in the figure below.

Figure 6-15: User Input Sections -Power Sub-Transmission Unit Cost Estimator



37	**Provision of SCADA Facility (No)**	
38	Central Event Monitoring and Evaluation system, Remote Terminal Unit (RTU) Micom C264 Complete with radio and wire all SCADA alarm and signal command points in individual control panels to RTU (Complete with all accessories to make functional)	0
39		
40	**Civil Works & Earth Grid (No)**	
41	50 Sq. mm. Copper Earth Grid for land area Xm by Xm	0
42	All relevant civil works associated with the substation work (Lot)	0
43		
44	**Power & Control Cables (No)**	
45	(m)	0
46	1x500sq.mm XLPE(11kV) Copper Cable for the connection of the Power Transformers to the 11kV Transformer Cubicle (m)	0
47		
48		
49		
50	PRIMARY SUB-STATION (INDOOR & OUTDOOR)	
51		
52	**33kV Indoor 2000A Single Busbar Switchgear - GIS (No)**	
53	33kV I/D Feeder Panel, c/w 1250A CB, VTs & 600/1200/5/5A 2-Core CTs	0
54	33kV I/D Busbar Coupler Cubicle c/w 2000A CB & 1000/2000/5/5A 2-core CTs	0
55		
56	**11kV Indoor Switchgear - 2000A Busbar Rating- GIS (No)**	
57	11kV I/D Feeder Cubicle C/W 630A CB, Overcurrent and Earthfault Relays, Metering CTs, Reclosing Relays and Sensitive Earthfault Relays, Earth Switch	0
58	1kV I/D Transformer Cubicle, C/W 2000A CB, Overcurrent and Earthfault Relays. Differential and Metering	0
59	11kV Auxilliary transformer Cubicle equipped with Fuse and the switchgear should be SCADA ready	0
60	11kV I/D Sectionalising Cubicle C/W 2000A CB, Protection and Metering CTs and Relays: the isolators should be motorised and the switchgear should be SCADA ready	0
61		
62	**33kV Outdoor Incomer/Feeder Bay (No)**	
63	33kV O/D 1250A Circuit Breaker c/w Support Structures	0
64	3kV O/D CT (600/300/5/5A) c/w Metallic Support Structure for the outgoing feeders	0

62	**33kV Outdoor Incomer/Feeder Bay (No)**	
63	33kV O/D 1250A Circuit Breaker c/w Support Structures	0
64	3kV O/D CT (600/300/5/5A) c/w Metallic Support Structure for the outgoing feeders	0
65		
66	**33kV Outdoor Transformer Bay (No)**	
67	33kV O/D 1250A Circuit Breaker c/w Support Structures	0
68		
69	**Power Transformer, OLTC Panel & NGRs (No)**	
70	20/26 MVA ONAN/ONAF 33/11kV Power Transformer with indoor busings	0
71	10/13 MVA ONAN/ONAF 33/11kV Power Transformer with indoor busings	0
72	5MVA ONAN/ONAF 33/11kV Power Transformer with indoor busings	0
73	2.5MVA ONAN/ONAF 33/11kV Power Transformer with indoor busings	0
74		
75	**Auxiliary Power Supply Equipment (DC &AC) (No)**	
76	100kVA Auxiliary Transformer 11kV/400V/220V for indoor stations	0
77		
78		
79	**Power & Control Cables (m)**	
80	1x500sq.mm XLPE(33kV) Copper Cable for the connection of the Power Transformers to the 33kV Transformer Cubicle (1 run/phase)	0
81	1x300sq.mm XLPE(11kV) Copper Cable for the connection of the Power Transformers to the 11kV Transformer Cubicle (3 runs/phase) (m)	0
82	4 x 95sq.mm XLPE (LV) Al Cable for connection between auxilliary transformer and LV AC Distribution Board (m)	0
83		
84	**Civil Works & Earth Grid (m2)**	
85	150 Sq. mm. Copper Earth Grid for Xm by Xm	
86	Foundation of lighting structure or lightning mast (no)	0
87		


TOWER CONSTRUCTION
Distance From Warehouse.
Distance from Warehouse to Project Site (km)
Double Circuit Tower Lines (km)
Tower Type SS (0°-3°) - 400sq.mm AAC
Tower Type AC (3°-60°) - 400sq.mm AAC
Tower Type DE (30°-60°) - 400sq.mm AAC
Tower Type 90° - 400sq.mm AAC
Civil Works (Tower Foundation) (No)
Tower Type SS (0°-3°)
Tower Type AC (3°-60°)
Tower Type 90°
Tower Type DE (30°-60°)
Rocky Excavation (Number)
33kV NETWORK UNDERGROUND
ROUTE DETAILS (in metres)
FEEDER 1
Gutter (G)
Gutter Cable Truss (G)
Road (Asphalt (R(A))
Road (Butimen)
Road (pavement)
Road (normal ground) R(NG)
Pavement (P)
Concrete (C)
Entrances (pavement)
Entrances (normal ground) E(NG)
Entrances (concrete) E(C)


Entrances (Bitumen)
Entrances (Tiles)
Grassed Surfaces
Tiled Surfaces
Normal Ground (NG)
Number of Underground Circuits in same trench (of 3 cables per cct)
4-inch thrust boring (m)
6-inch thrust boring (m)
Number of thrust boring locations
Excavation and reinstatement in rocky ground (m)
Number of Indoor Termination for 1 x 630sq.mm XLPE
Number of Outdoor Termination for 1 x 630sq.mm XLPE
Number of joint
Cable Truss (m)
11kV NETWORK UNDERGROUND
UNDERGROUND (UG) CIRCUITS TO BE CREATED (No)
Double circuit trench (11kV)
Single circuit trench (11kV)
UNDERGROUND CABLE PORTION
FEEDER 1
LENGTH (m): 1X240Al
LENGTH (m): 3X185Al
Number of Underground Circuits in same trench
4-inch thrust boring (m)
6-inch thrust boring (m)
Number of thrust boring locations
Pavement Block Surfaces (m)
Concrete Surfaces (m)
Grassed Surfaces (m)
Number of entrances to cross
Number of joints for 1x240mm²Al
Number of joints for 3x185mm²Al
Number of EOS per set
Number of EPS per set
Cable Truss (m)
Number of Outdoor Terminations for 1x240mm²Al
Number of Indoor Terminations for 1x240mm²Al
Number of Outdoor Terminations for 3 x 185mm² Al
Number of Indoor Terminationsfor 3x185mm²Al
Sub-total: Bulk Supply Point
Sub-total: Primary Sub-station Indoor & Outdoor
Sub-total: Tower Construction
Sub-total: 33kV Network Underground
Sub-total: 11kV Network Underground
Contingency (10%)
Grand Total USD (33kV Sub-Transmission Network)
USD

Once the user enters the various values for each of the corresponding cost drivers, the power sub-transmission unit cost tool will automatically generate results for the following based on the entries made:

- Sub-total: Bulk Supply Point;
- Sub-total: Primary Sub-station Indoor & Outdoor;
- Sub-total: Tower Construction;
- Sub-total: 33kV Network Underground;
- Sub-total: 11kV Network Underground;
- Contingency (10%);
- Grand Total (GHS); and
- Grand Total USD.

This is shown in figure 6-16 below.

Figure 6-16: Power Sub-Transmission Unit Cost and Cost Estimate Output

6.8.1. Summary of Steps-Power Sub-Transmission Unit Cost Estimator

1. Enter the applicable value or number in the input required sections; and
2. The following results will be generated:
   - Sub-total: Bulk Supply Point;
   - Sub-total: Primary Sub-station Indoor & Outdoor;
   - Sub-total: Tower Construction;
   - Sub-total: 33kV Network Underground;
   - Sub-total: 11kV Network Underground;
   - Contingency (10%);
   - Grand Total (GHS); and
   - Grand Total USD.

Key Points to note on the use of the Power Sub-Transmission Unit Cost Estimator

- It is recommended that the tool should be used by a technical person who understands and can interpret the content. All results and interpretations are the sole responsibility of the user;
- The contract cost data used comprise solely of project costs for various power sub-transmission infrastructure projects at the **award prices**. It therefore expresses how much it would cost for the transmission of 33kV power without consideration of any variations, extensions of time or any other changes to the original contract awarded;

- The output of the unit cost estimator for power sub-transmission feeds into the budget tool. The power sub-transmission infrastructure cost and budget tool estimate are expressed in **USD**; and
- To avoid errors, it is suggested that the user only inputs absolute values i.e. 1, 2, 3 etc. for the various components in the applicable areas.

6.9. How to use the Power Sub-Transmission Budget Tool

The cost estimate derived from the unit cost estimator i.e. Grand Total (USD) feeds into the budget tool as the **'Infrastructure Cost'.** Users are only required to provide input in the form of percentages for the 9 budget line items as shown in Figure 6-17 at the **'User Budget Provision'** column of the tool. The **'Provision guidance'** should enable the user to apply some informed basis to select an appropriate percentage required under the **'User Budget Provision.**

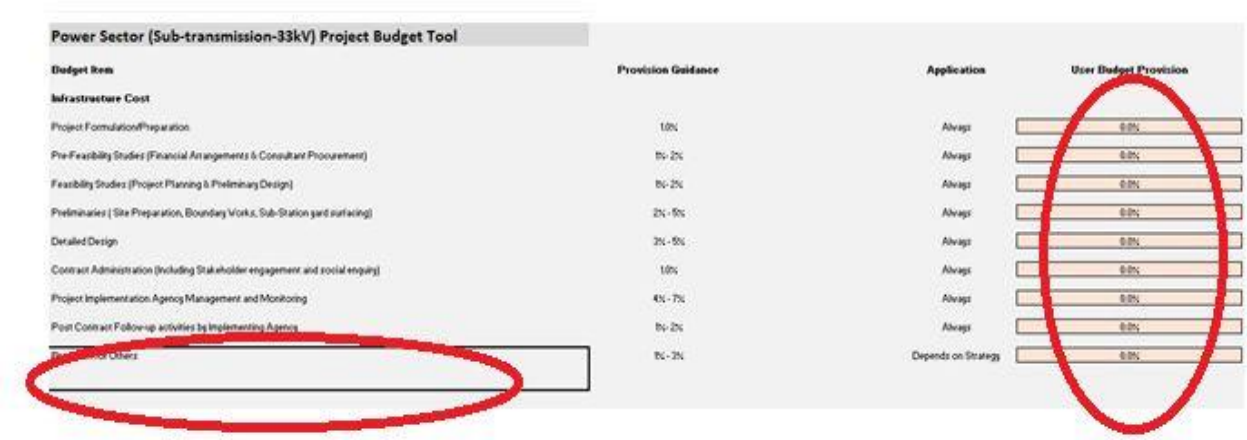
The budget line items for which users would provide the input include:

- Project Formulation/Preparation;
- Pre-Feasibility Studies (Financial Arrangements & Consultant Procurement);
- Feasibility Studies (Project Planning & Preliminary Design);
- Preliminaries (Site Preparation, Boundary Works, Sub-Station yard surfacing);
- Detailed Design;
- Contract Administration (Including Stakeholder engagement and social enquiry);
- Project Implementation Agency Management and Monitoring;
- Post Contract Follow-up activities by Implementing Agency; and
- Provision for Others.

The budget tool as mentioned earlier also allows the user to enter any additional items that may not fall within the items above set within the project budget tool for the sector. These include items such as:

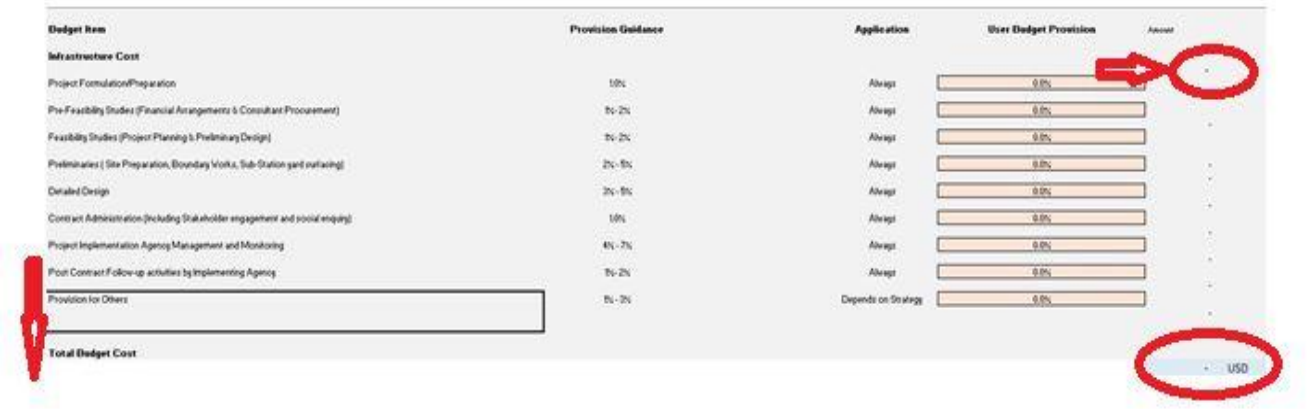
- Land acquisition; and
- Environmental and Social Impact Assessment etc.

Figure 6-17: User Input Section – Power Sub-Transmission Budget Tool



Once the user inputs the budget provision percentages for each of the corresponding budget line items, the power sub-transmission budget tool will report a budget estimate i.e. '**Total Budget Cost'.** The total budget cost will be derived from the outcomes of the budget line items calculated as percentages of the Infrastructure Cost and added to the initial infrastructure cost amount obtained from the unit cost estimator (See Figure 6-18)

Figure 6-18: Power Sub-Transmission Total Budget Cost Output



Key Points to note on the use of the Power Sub-Transmission Budget Tool

- The output of the unit cost estimator for power sub-transmission feeds into the budget tool. The power sub-transmission unit cost and budget tool estimate are expressed in **USD**;
- To avoid errors, it is suggested that the user only inputs the absolute values i.e. 1, 2, 3 etc. for the various components in the applicable areas; and
- It is also recommended that users consider the provision guidance in making their input. It is worth noting that these guidelines were derived based on expert experience as well as from interactions with key stakeholders within the sector

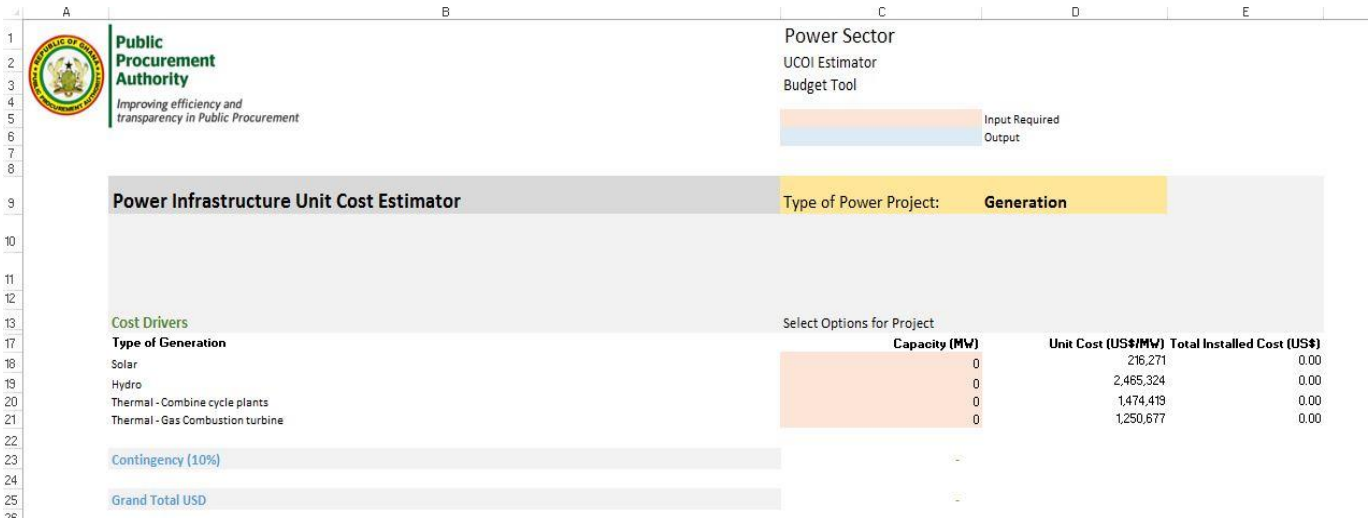
6.10. User Interface- Power Generation

The unit cost estimator for power generation was developed based on the types of generation currently existent in the power sector. This is mainly made up of the following:

- Solar;
- Hydro;
- Thermal – Combine Cycle Plants; and
- Thermal – Gas Combustion Turbine

A screen shot of the user interface for the power generation unit cost estimator is shown in figure 6-19 with the cost drivers and the window where the unit cost output is presented.

Figure 6-19: User Interface of the Power Generation Unit Cost Estimator



6.10.1. Power Generation Budget Tool

The power generation budget tool allows the user to include the cost of other factors that relate to the development of a power generation infrastructure project. Similar to the other budget tools, the budget tool for power generation was developed based on the experience of power sector experts as well as based on interactions with the key stakeholders in the sector in Ghana.

The identified elements of the buildings sector project budget tool include budget allocation for:

- Project Formulation/Preparation;
- Pre-Feasibility Studies (Financial Arrangements & Consultant Procurement);
- Feasibility Studies (Project Planning & Preliminary Design);
- Preliminaries (Site Preparation, Boundary Works, Sub-Station yard surfacing);
- Detailed Design;
- Contract Administration (Including Stakeholder engagement and social enquiry);
- Project Implementation Agency Management and Monitoring;
- Post Contract Follow-up activities by Implementing Agency; and
- Provision for Others.

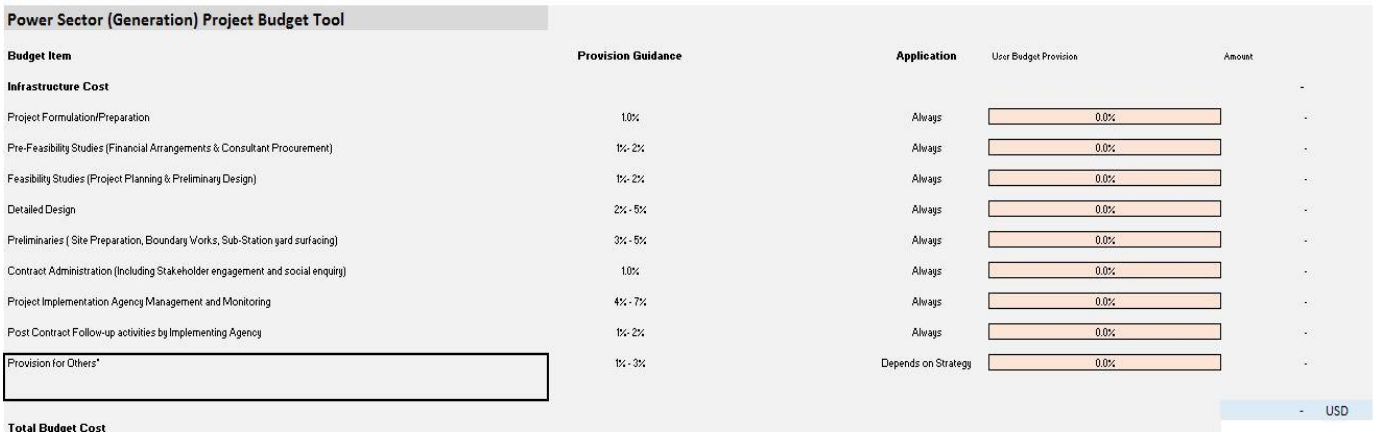
Provision was made as a guide to what proportion of the initial infrastructure cost should be allocated to the above items. These options can be seen under the **'Provision Guidance'** header. This enables the user to apply some informed basis to selecting an appropriate percentage where his or her input is required under the **'User Budget Provision'**. Here, the user can enter a percentage value for any of the applicable items provided.

The budget tool for the power generation sector also allows the user to enter any additional items that may not fall within the items above set within the project budget tool for the sector. These include items such as:

- Land acquisition; and
- Environmental and Social Impact Assessment etc.

Below is a screenshot of the power generation budget tool.

Figure 6-20: User Interface of the Power Generation Unit Cost Estimator



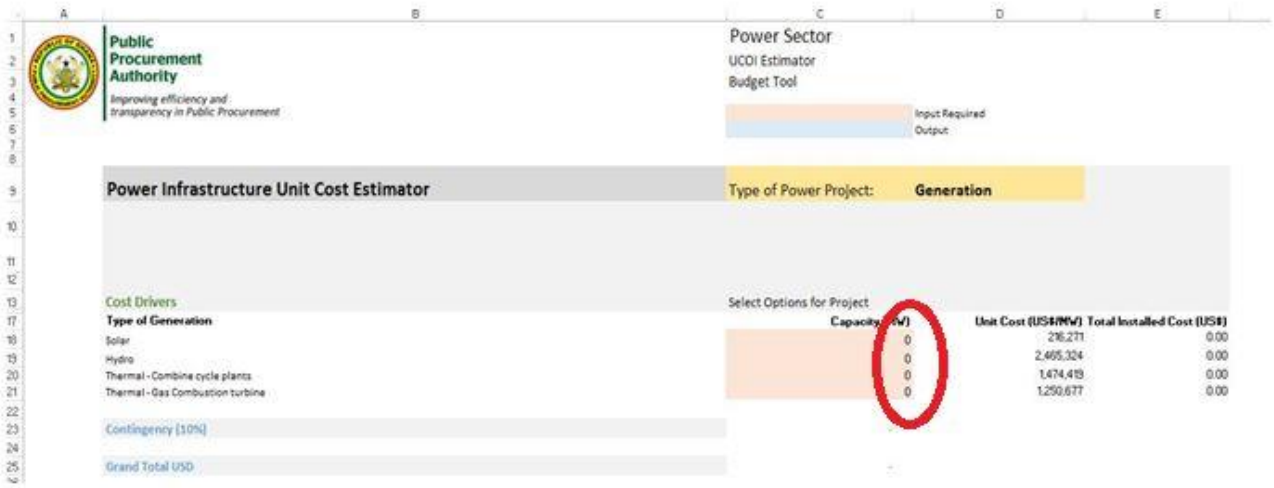
Power Sector (Generation) Project Budget Tool

Budget Item	Provision Guidance	Application	User Budget Provision	Amount
Infrastructure Cost				-
Project Formulation/Preparation	1.0%	Always	0.0%	-
Pre-Feasibility Studies (Financial Arrangements & Consultant Procurement)	1%- 2%	Always	0.0%	-
Feasibility Studies (Project Planning & Preliminary Design)	1%- 2%	Always	0.0%	-
Detailed Design	2% - 5%	Always	0.0%	-
Preliminaries (Site Preparation, Boundary Works, Sub-Station yard surfacing)	3% - 5%	Always	0.0%	-
Contract Administration (Including Stakeholder engagement and social enquiry)	1.0%	Always	0.0%	-
Project Implementation Agency Management and Monitoring	4% - 7%	Always	0.0%	-
Post Contract Follow-up activities by Implementing Agency	1%- 2%	Always	0.0%	-
Provision for Others*	1% - 3%	Depends on Strategy	0.0%	-
Total Budget Cost				- USD

6.11. How to use the Power Generation Unit Cost Estimator

The power generation unit cost estimator only requires users to make inputs or entries for the applicable cost drivers and components for their project. The input sections of the power distribution unit cost estimator are highlighted in the figure below.

Figure 6-21: User Input Sections -Power Generation Unit Cost Estimator

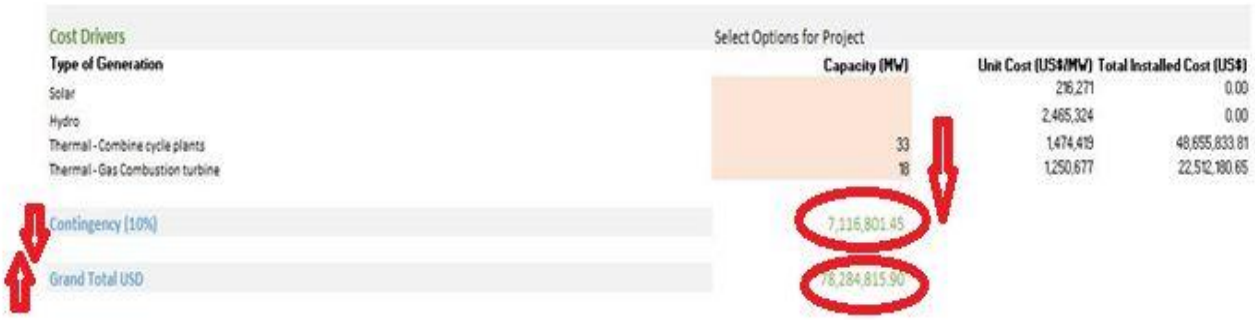


Once the user enters the various values for each of the corresponding cost drivers, the power generation unit cost tool will automatically generate results for the following based on the entries made:

- Contingency (10%);
- Grand Total USD.

This is further illustrated in figure 6-22 below.

Figure 6-22: Power Generation Unit Cost and Cost Estimate Output



6.11.1. Summary of Steps-Power Transmission Unit Cost Estimator

- Enter the applicable value or number in the input required sections; and
- Results for the following will be generated:
  - Contingency (10%);and
  - Grand Total USD.

Key Points to note on the use of the Power Generation Unit Cost Estimator

- It is recommended that the tool should be used by a technical person who understands and can interpret the content. All results and interpretations are the sole responsibility of the user;
- The contract cost data used comprise solely of project costs for various power generation infrastructure projects at the **award prices**. It therefore expresses how much it would cost to generate power without consideration of any variations, extensions of time or any other changes to the original contract awarded;
- The output of the unit cost estimator for power generation feeds into the budget tool. The power generation infrastructure cost and budget tool estimate are expressed in **USD**; and
- To avoid errors, it is suggested that the user only inputs absolute values i.e. 1, 2, 3 etc. for the various components in the applicable areas.

6.12. How to use the Power Generation Budget Tool

The cost estimate derived from the unit cost estimator i.e. Grand Total (USD) feeds into the budget tool as the **'Infrastructure Cost'.** Users are only required to provide input in the form of percentages for the 9 budget line items as highlighted in Figure 6-23 at the **'User Budget Provision'** column of the tool. The **'Provision guidance'** should enable the user to apply some informed basis to select an appropriate percentage required under the **'User Budget Provision.**

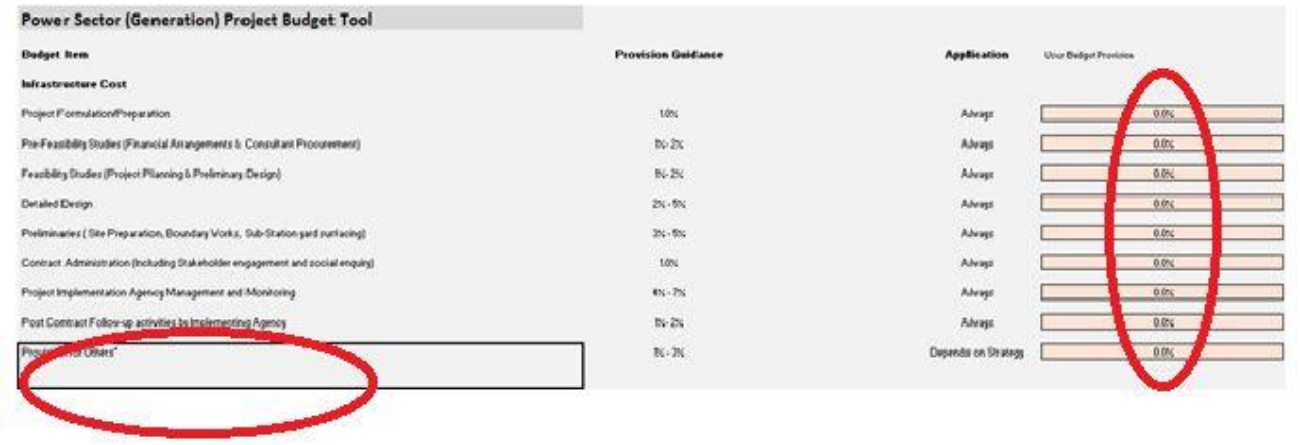
The budget line items for which users would provide the input include:

- Project Formulation/Preparation;
- Pre-Feasibility Studies (Financial Arrangements & Consultant Procurement);
- Feasibility Studies (Project Planning & Preliminary Design);
- Preliminaries (Site Preparation, Boundary Works, Sub-Station yard surfacing);
- Detailed Design;
- Contract Administration (Including Stakeholder engagement and social enquiry);
- Project Implementation Agency Management and Monitoring;
- Post Contract Follow-up activities by Implementing Agency; and
- Provision for Others.

The budget tool as mentioned earlier also allows the user to enter any additional items that may not fall within the items above set within the project budget tool for the sector. These include items such as:

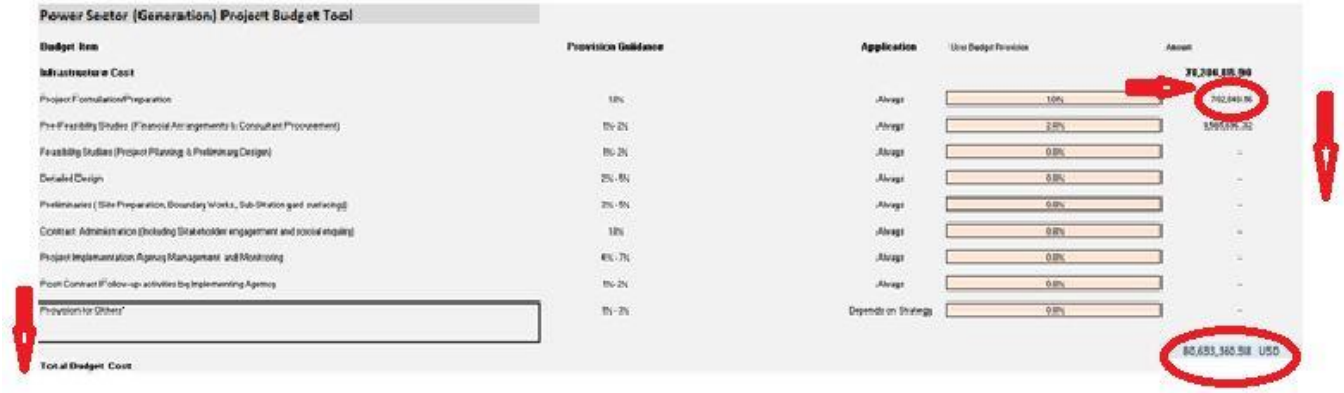
- Land acquisition; and
- Environmental and Social Impact Assessment etc.

Figure 6-23: User Input Section - Power Generation Budget Tool



Once the user inputs the budget provision percentages for each of the corresponding budget line items, the power generation budget tool will report a budget estimate i.e. '**Total Budget Cost'.** The total budget cost will be derived from the outcomes of the budget line items calculated as percentages of the Infrastructure Cost and added to the initial infrastructure cost amount obtained from the unit cost estimator (See Figure 6-24)

Figure 6-24: Power Generation Total Budget Cost Output



Key Points to note on the use of the Power Generation Budget Tool

- The output of the unit cost estimator for power generation feeds into the budget tool. The power generation unit cost and budget tool estimate are expressed in **USD**;
- To avoid errors, it is suggested that the user only inputs the absolute values i.e. 1, 2, 3 etc. for the various components in the applicable areas; and
- It is also recommended that users consider the provision guidance in making their input. It is worth noting that these guidelines were derived based on expert experience as well as from interactions with key stakeholders within the sector.