# MAINSTREAMING MINI-GRID TARIFF SETTLEMENT TOOLS AND METHODOLOGIES ACROSS AFRICAN REGULATORS

Baseline Gap Analysis Report and Early Recommendations for Structuring of Enhanced Tool: Tariff settlement tools uptake, utilization, gaps, challenges in Zambia, Tanzania, Kenya, Sierra Leone, and Nigeria, as cases

Final Report submitted to African Forum for Utility Regulators (AFUR) by AESG

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| | |
|---|---|
| AfDB | African Development Bank |
| AFUR | African Forum for Utility Regulators |
| AMDA | Africa Mini-grid Developers Association |
| AU | African Union |
| AUDA | African Union Development Agency - NEPAD |
| CAPEX | Capital Expenditure |
| COMESA | Common Market for Eastern and Southern Africa |
| CoSS | Cost of Service Study |
| ECOWAS | Economic Community of West African States |
| E4I | Energy 4 Impact |
| ERA | Electricity Regulatory Authority (of Uganda) |
| EU | European Union |
| EPRA | Energy and Petroleum Regulatory Authority |
| ERB | Energy Regulation Board (of Zambia) |
| ERERA | ECOWAS Regional Electricity Regulatory Authority |
| ERI | Electricity Regulatory Index (of the AfDB) |
| ESMAP | Energy Sector Management Assistance Program |
| EWRC | Electricity and Water Regulatory Commission (of Sierra Leone) |
| EWURA | Energy and Water Utilities Regulatory Authority |
| FCDO | Foreign Commonwealth and Development Office |
| FiT | Feed-in Tariffs |
| GEDAP | Ghana Energy Development and Access Project |
| GIZ | Gesellschaft für Internationale Zusammenarbeit |
| IRENA | International Renewable Energy Agency |
| IRR | Internal Rate of Return |
| kWh | Kilowatt hour |
| MW | Megawatt |
| MYTO | Multi Year Tariff Order |
| NARUC | National Association of Regulatory Utility Commissioners |
| NEPAD | New Partnership for African Development |
| NERC | Nigerian Electricity Regulatory Commission |
| NREL | National Renewable Energy Laboratory |
| O&M | Operating and Maintenance |
| OPEX | Operating Expenditure |
| RBF | Result-Based Financing |
| REF | Rural Electrification Fund |
| RERA | Regional Electricity Regulators' Association of Southern Africa |
| REPP | Renewable Energy Performance Platform |
| ROI | Return on Investment |
| SADC | Southern African Development Community |
| SLEWRC | Sierra Leone Electricity and Water Regulatory Commission |
| SPPs | Small Power Producers (<100kW installed capacity) |
| SuRE | Scaling Up Renewable Energy (A program of Power Africa) |
| TANESCO | Tanzania Electric Supply Company |
| TEA | The Transforming Energy Access Platform |
| ToU | Time of Use |
| UK | United Kingdom |
| USAID | United States Agency for International Development |
| VAT | Value Added Tax |
| WACC | Weighted Average Cost of Capital |
| ZERA | Zimbabwe Energy Regulatory Authority |

# 4 Executive Summary

## 4.1 Introduction

The project "Mainstreaming mini-grid tariff settlement tools and methodologies across African Regulators" commenced in April 2021 with approval of an implementation workplan by the project steering committee (PSC). The Workplan provides for the submission of a Baseline Gap Analysis Report as one of the deliverables in the performance of the project activities. This Baseline Gap Analysis Report provides an understanding of the current mini grid tariff settlement frameworks uptake, utilization, challenges, gaps of the tariff settlement tools in five select countries, Nigeria, Sierra Leone, Tanzania, Kenya and Zambia. This Baseline Gap Analysis Report, along with the literature review report submitted earlier in the project, forms the foundation for the recommended structuring of improved tariff settlement tools for AFUR.

The project is being implemented by African Forum for Utility Regulators (AFUR) in partnership with the Africa Mini-grid Developers Association (AMDA). The project and this material are funded by UK aid from the UK government through the Transforming Energy Access (TEA) platform; however, the views expressed do not necessarily reflect the UK government's official policies. TEA works via partnerships to support emerging clean energy generation technologies, productive appliances, smart networks, energy storage and more. The TEA platform increases access to clean, modern energy services for people and enterprises in sub-Saharan Africa and South Asia, improving their lives, creating jobs and boosting green economic opportunities.

## 4.2 Project Rationale, Objectives and Outcomes

In Sub-Saharan Africa, not all population have access to electricity, and electrification rates are particularly low especially in rural areas. Off-grid renewable energy solutions will be key to achieve universal access to electricity in Sub-Saharan Africa. But mini-grids development is still hampered by several factors including a challenging regulatory and political environment. Mini grid tariff settlement processes tend to be cumbersome and lengthy for developers and regulators alike. Governments have an important role in facilitating private sector participation, by creating a conducive business climate for more private investors to participate in the generation and delivery of the power to the unserved population. A conducive business climate includes providing a cost reflective tariff to the investors/developers as one way of ensuring economic viability for private sector mini grids. Tariffs as one of the main revenue streams affect project cash flows, the availability of funds for management, operation and maintenance, and recovery of investment cost. This project seeks to engage various regulators around cost-plus/cost recovering mini-grids tariff tools as an effective approach to tariff setting across African Forum for Utilities Regulators (AFUR) members. This is so as to deliver a fair return for private sector capital. Tariff tools also offer the additional benefits of transparency around cost incurred by both the developer and potentially public entity (i.e., utility, rural electrification funds, regulator where applicable) and as such can inform the design of a result-based financing (RBF) where applicable.

The project objectives are to: (a) Review of existing tariff settlement methodologies such as Nigeria, Sierra Leone, Kenya, Tanzania and Zambia, (b) develop an enhanced standardised tariff settlement tool for African regulators to streamline the process for developers based on the review of the existing tools, (c) conduct an in-depth stakeholder engagement process to collate feedback on the tool developed more specifically from regulators and ministries, as well as AMDA as a representative of the private sector (d) support at least three AFUR members to adopt the tool.

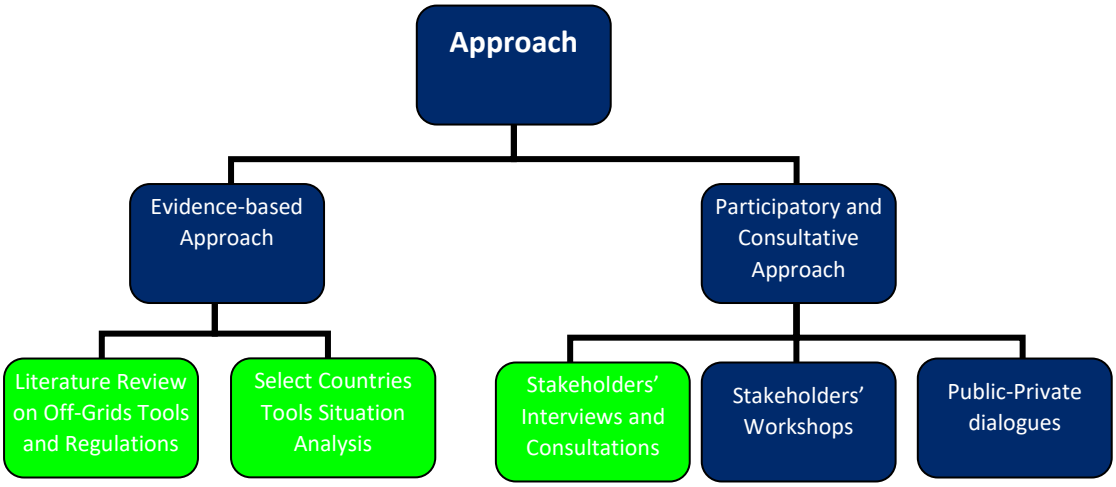
The expected project outcomes are (a) Streamlined tariff settlement processes that allow for investor-attractive off-grid energy tariffs, (b) Increased capacity building for African regulators on mini-grid

tariff tools. (c) Increased engagement on investor friendly mini-grid tariff settlements between the public and private sector, (d) Successful facilitation of a clear debate on the interaction between tariffs, connection numbers and subsidy per connection.

## 4.3 Approach and Methodology

The methodology will entail a combination of (i) evidence-based approach, and (ii) participatory consultative approach. This approach is illustrated in the following pictogram:

Figure 1: Approach




In the evidence-based approach, the project reviewed existing tariff settlement tools of five countries: Nigeria, Sierra Leone, Zambia, Tanzania, and Kenya. The tools were analysed using a standardised template of pre-identified salient features expected of a tariff tool. These salient features were informed by a literature review of regulatory practices. The literature review report was concluded earlier in the performance of this project[1]. The analysis identified common features to carry forward as well as gaps in the individual tools that could be addressed in the enhanced tool. In the participatory consultative approach, questionnaires were prepared each category of the stakeholders that were consulted. The questionnaires were emailed to these stakeholders followed by virtual interviews. Virtual interviews were conducted with regulators that own the tools for their experiences using their respective tools. The regulators validated the objectives of their tariff settlement tools, shared the challenges and lessons learned from using their tools and provided inputs to the solution. Additional stakeholder groups that were engaged include the developers of mini grids, the funders (donors and investors) of the mini grids and some countries' ministries of energy.

From the literature review, the analysis of the five countries tools, experiences, learnings and proposals of the stakeholders, the project collated the baseline gaps in tariff settlement tools presented in this report. This baseline gaps analysis report along with the proposals for structuring an enhanced tariff tool will be shared with stakeholders in a future workshop for validation. The validated proposals will guide the development of an enhanced mini grid tariff settlement tool for AFUR.

## 4.4 Review of existing tariff tools and identified gaps

The project activity assessed tariff settlement tools of each of the five country regulators: Zambia, Tanzania, Kenya, Sierra Leone and Nigeria. The tool assessment covered the following elements: -

[1] The report is available for download from the AFUR website and project page:

1) Tariff application requirements, approval processes and timelines
2) Tariff tools overview and inputs required
3) Tariff tools outputs – revenue requirement, tariff structures, and sensitivity analysis
4) Challenges/Lessons learned from using these tariff tools

In all the countries, their tariff tool is anchored in mini grid regulations that spell out, the size of mini grids that are eligible for regulation, the tariff application processes, application requirements, and timelines to regulatory approval. These timelines varied from country to country ranging from 30 days to 90 days. The uptake of these tools is growing with both Kenya and Nigeria reporting increasing tariff applications that have been processed using their respective tools. All the tools are based on the cost of service (or rate of return) tariff methodology and hence the inputs into the tariff tools enable calculation of the revenue requirement based on the of the cost of service formula.

The analysis of each tool against the pre-defined criteria identified some tool-specific gaps that could be improved on. It was noted that some countries mini grids regulations do not allow portfolio tariff application and therefore those countries' tools also did not provide for such a functionality. Some of the recurring gaps are: a tool does not provide for input of working capital; a tool does not provide for annual adjustments of items like foreign exchange and inflation during the tariff control period; a tool does not allow for portfolio tariff application as a tariff is tied to a site; a tool does not specify input variables that are fixed; the sources of information (exchange rates, inflation rate) is not specified; a tool does not consider the avoided cost in the ability and willingness to pay analysis; a tool does not provide for a valuation of mini grid assets when the grid arrives; and a tool does not provide for sensitivity analysis. It was also felt that some of the tools were too complicated.

It is recommended that these gaps, to the extent possible, be addressed in the enhancements to the tariff settlement tools.

## 4.5 Experiences and lessons learned using existing tools and improvements proposals

Stakeholders recognise that a lot of progress that has been made in the mini grids tariff setting. Despite this progress, developers indicated that there are still concerns to be addressed to improve the tariff settlements.

Markets and the political establishment want lower tariffs. But these lower tariffs are not cost reflective, and the push for a lower tariff does not come with subsidy support. The subsidy burden is left to the developer. The proposal is that the drive for lower tariffs should be backed by commensurate subsidies to balance affordability by consumers with mini grid sustainability. It is important to get governments buy-in on tariff settlement frameworks.

At times there is a disconnect between the promulgated regulations and ad hoc political directives. The proposal is that policy certainty and policy stability is required once investors make commitments based on existing frameworks to protect mini grid viability.

The regulations generally provide for timelines for the tariff processing which ranges between 30 days and 90 days in the countries whose tariff tools were reviewed. However, experience shows that the tariff approvals are not always being made within the timelines prescribed in the regulations. The proposal is to address the bottlenecks, including providing training to the regulators on use of the tariff tool to speed up approvals.

The regulated electricity supply industry is by nature complex and its regulation is a specialised discipline. It was therefore observed that some of the tools are complicated to some users and need a lot of information to get the tariff output. The proposal is to balance between the level of details

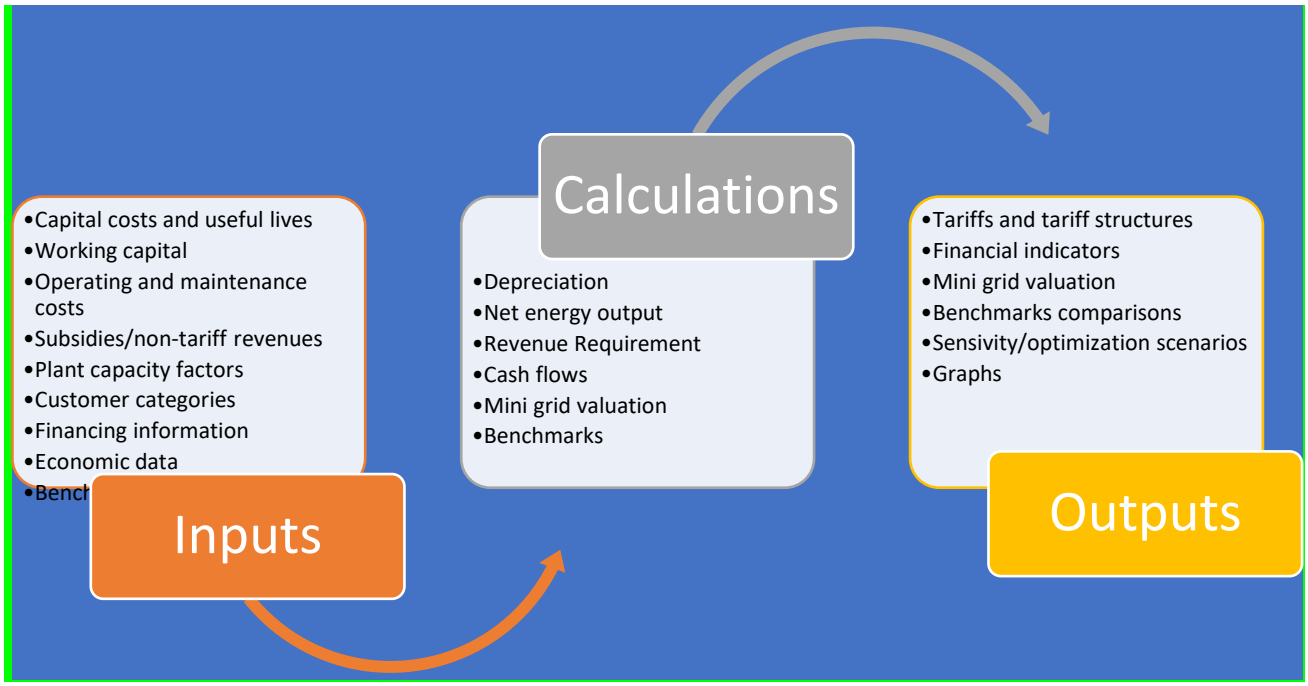
requested by regulators in tariff tool and the developers' preferred broad information categories. The tool also needs to balance between simplicity and accuracy-the more functionalities required the more complex and bulkier the tool becomes.

## 4.6 Early Proposals for structuring an enhanced tariff tool

A range of proposals covering the entire mini grid policy and regulatory framework (legal licensing and provision, cost recovery and tariff regulation, financing support to mini grids, grid interconnection upon grid arrival) were provided. Our early proposal for structuring on tariff settlement focuses on cost recovery and tariff regulation in line with the project objectives. This early proposal covers the following: 1) Tariff methodology underlying the tariff tool (i.e., the cost of service methodology; 2) The tool (a) Input variables, (b) Calculations, (c) Outputs and sensitivity analysis, (d) User guide. The sensitivity analysis functionality will allow for varying inputs to get outputs as well as swapping the outputs to be inputs e.g., tariff as an input to get subsidy as an output; trade-offs between subsidies, tariffs and number of connections, trade-offs whether increasing subsidies to get more connections or lower subsidies with less connections.

The following schematic shows these structural elements as three main areas of inputs, calculations, and outputs.

Figure 2: Inputs, Calculations and Outputs




## 4.7 Other proposals from stakeholders

### 4.7.1 Capitalising operating expenses to lower tariffs in the early years versus deferring revenues

The choice here is whether to defer expenses or to defer revenues. The regulatory practice is to defer revenues (i.e., revenue shortfalls are deferred for recovery in future years). These deferrals are provided for in Regulatory Deferral Accounts (regulatory debits and regulatory credits) in terms of international financial reporting standard 14. It is proposed for this tool to use the regulatory deferrals as provided for in regulatory practice.

### 4.7.2 Price elasticity of demand

The concept of incorporating the impact of reducing mini grid tariffs on customer consumption (price elasticity of demand) and grid Net Present Value (NPV) derives from the CBEA Lab pilot that tested the

impact of lower tariffs on customers, developers, and subsidies. In the pilot starting in June 2018 CBEA Lab funded developers to reduce tariffs by between 50% and 75% at five rural mini grid sites in Tanzania. During the 5- year pilot, the Lab provides a 5-year subsidy that allows developers to reduce tariffs charged to customers and not have a negative impact on project returns (NPV). The pilot headline findings show that:

1. "Governments cannot mandate lower tariffs without seriously damaging the business case for mini grid developers, and developers should not introduce them without financial support. The tariff reductions implemented under this prototype resulted in a decrease in average Net Present Value (NPV) of 13%, excluding subsidy payments.
2. Tariff subsidies benefit all categories of mini grid customers, but the greatest impact is felt by the lowest using, and likely lowest income customers (Low using customers are the most price sensitive of all customer groups, and ready to use more power). As a result, less subsidy is required than is typically provided to the main grid because the increase in consumption reduced the amount of lost revenue that subsidy needs to bridge. "

*(Source: Innovation Insight: Measuring the impact of reducing mini-grid tariffs on customer consumption and grid NPV, Cross Boundary and Energy4Impact, September 2020)*

For this AFUR project of developing an enhanced tool the price elasticity functionality will be provided for in the tool as a standalone sensitivity analysis scenario. Given the CBEA Lab pilot was conducted in only one country (Tanzania) and on just three project sites, the data on price elasticities is still limited for a standardised approach across countries. The tool will provide flexibility for the developers to input the parameters required for conducting this price elasticity of demand analysis. The functionality in the tool will allow developers to input baseline tariff, baseline average consumption per user (ACPU), baseline average revenue per user (ARPU), baseline NPV, the elasticity/relationship between tariff and demand for different customer profiles, the time/months it takes from tariff reduction to when ARPU returns to baseline. The output will be the required subsidy to achieve NPV neutrality, reduced tariff (i.e., what the price needs to fall to for extra demand). It is noted from the pilot that, "at sites where demand is close to generating capacity, serving new connections may also require additional investment in generating capacity that reduces overall project returns", and therefore this capacity constraint (grid optimisation consumption analysis) is important in the modelling.

## 4.8 Conclusion

This baseline analysis presents the gaps in the respective country mini grid tariff tools, the experiences and lessons by the regulators and developers in using existing tools along with the proposals for improvements. It also presents the funders' areas of concern along with their proposals to address those concerns. This report also provides some policy makers' perspectives on role of mini grids in rural electrification, their countries' respective regulatory frameworks and tariff settlement.

This report is informative to mini grids stakeholders by highlighting current practical bottlenecks and lays the foundation for the public-private dialogues on enhancements to mini grids regulatory frameworks and tariff settlements in the continent. It contributes to the knowledge base, knowledge sharing and peer to peer learning amongst the AFUR network of regulators. It complements the recommendations from the literature review conducted earlier in the project to enhance mini grid regulatory practice in the continent.

# 5 Introduction

The project "Mainstreaming mini-grid tariff settlement tools and methodologies across African Regulators" commenced in April 2021. The project is being delivered by African Forum for Utility Regulators (AFUR) in partnership with the Africa Mini-grid Developers Association (AMDA). The project is funded by UK aid from the UK government through the Transforming Energy Access (TEA) program. TEA works via partnerships to support emerging clean energy generation technologies, productive appliances, smart networks, energy storage and more. TEA program increases access to clean, modern energy services for people and enterprises in sub-Saharan Africa and South Asia, improving their lives, creating jobs and boosting green economic opportunities.

The project commenced with the development and approval of the workplan by the project steering committee (PSC). This Baseline Gap Analysis Report provides an understanding of the current mini grid tariff settlement frameworks uptake, utilization, challenges, gaps in the tariff settlement tools of five countries, Nigeria, Sierra Leone, Tanzania, Kenya and Zambia. This Baseline Gap Analysis Report, along with the literature review report[2], form the foundation for the recommended structuring of improved tariff settlement tools for AFUR.

# 6 Project Rationale, Objectives, Activities and Outcomes

## 6.1 Project Rationale

In Sub-Saharan Africa, not all population have access to electricity, and electrification rates are particularly low especially in rural areas. Off-grid renewable energy solutions will be key to achieve universal access to electricity in Sub-Saharan Africa. A combination of: - decreasing technology costs, established track record of deployment, and ability to generate electricity rapidly have accelerated the case for adoption of mini-grid and isolated solutions. As a result, it is estimated that between 60-70% of the future electricity supply will be from off-grid systems (both isolated and mini-grids).

The African governments on their own cannot meet this future electricity supply needs and private sector investments will increasingly play an important role to plug the funding gap. Governments have an important role in facilitating private sector participation, as there is growing interest from the private sector in the development, financing, operation, and management of mini grids. To achieve this will entail placing less reliance on the centralized power supply (mostly by state monopoly) by creating a conducive business climate for more private investors participation in the generation and delivery of the power to the unserved population. A conducive business climate includes providing a cost reflective tariff to the investors/developers. Cost-covering tariffs are one way of ensuring economic viability for private sector mini-grids. Providing a cost reflective tariff is within the remit of regulators and governments policy makers. In most countries all off-grid/mini-grid developers are required by law to apply for an energy generation, distribution and retailing permit/license and are required to obtain an energy retail tariff approval from the regulators.

But mini-grids development is still hampered by several factors including a challenging regulatory and political environment. This is the case for tariff settlement processes which tend to be cumbersome and a lengthy process for developers and regulators alike. To date, standardised tariff-calculation methodologies have already been adopted by Nigeria, Sierra Leone, Tanzania, Kenya and Zambia. However, there tends to be a tariff cap linked with main grid tariffs despite the proposed tariffs from the existing tools. The tariff cap is explained by the fact that mini-grid tariffs tend to be higher than those for the main-grid – this disparity is often viewed through the lens of equality and fairness

[2] The literature review report was submitted to AFUR as part of this project

between rural and urban consumers. In this light, some countries impose national uniform tariffs (or keep mini-grid tariffs close to those of the main-grid), that are usually too low to allow sustainable mini-grid operation.

A number of countries have already turned to dedicated mini-grid policies and regulations to support participation of the private sector. A tailored approach to tariff regulation is an effective way to mobilise private sector investment in the sector as mini-grids tariff frameworks have a strong influence on the viability and sustainability of mini-grids, notably by affecting the operators' ability to set end-user tariffs. Although the expectations vary, tariffs as one of the main revenue streams affect project cash flows, the availability of funds for management, operation and maintenance, and recovery of investment cost.

In response to the above, this project seeks to engage various regulators around cost-plus/cost recovering mini-grids tariff methodologies as an effective approach to tariff setting across African Forum for Utilities Regulators (AFUR) members to deliver a fair return for private sector capital. Tariff tools also offer the additional benefits of transparency around cost incurred by both the developer and potentially public entity (i.e., utility, rural electrification funds, and regulator where applicable) and as such can inform the design of a result-based financing (RBF) where applicable.

## 6.2 Project Objectives

The project objectives are to: (a) Review of existing tariff settlement methodologies such as Nigeria, Sierra Leone, Kenya, Tanzania and Zambia, (b) develop an enhanced standardised tariff settlement tool for African regulators to streamline the process for developers based on the review of the existing tools, (c) conduct an in-depth stakeholder engagement process to collate feedback on the tool developed more specifically from regulators and ministries, as well as AMDA as a representative of the private sector (d) support at least three AFUR members to adopt the tool.

## 6.3 Project Activities

The activities performed to fulfil the project objectives include: (a) reviewing existing mini-grid tariff settlement tools of the five countries as cases; (b) in-depth stakeholder engagement process to highlight successes and understand practical challenges in tariff settlements both from the public and private sector perspective, (c) analysis to highlight the roles and responsibilities of key players and institutions that play a vital role in the administration of the mini grid tariff settlement tools, (d) analysis of current intervention models at national level with regard to the prevailing mini grid tariff settlement tools, (e) facilitating public -private dialogue during the project, and (f) structuring of an enhanced tariff tool for AFUR membership.

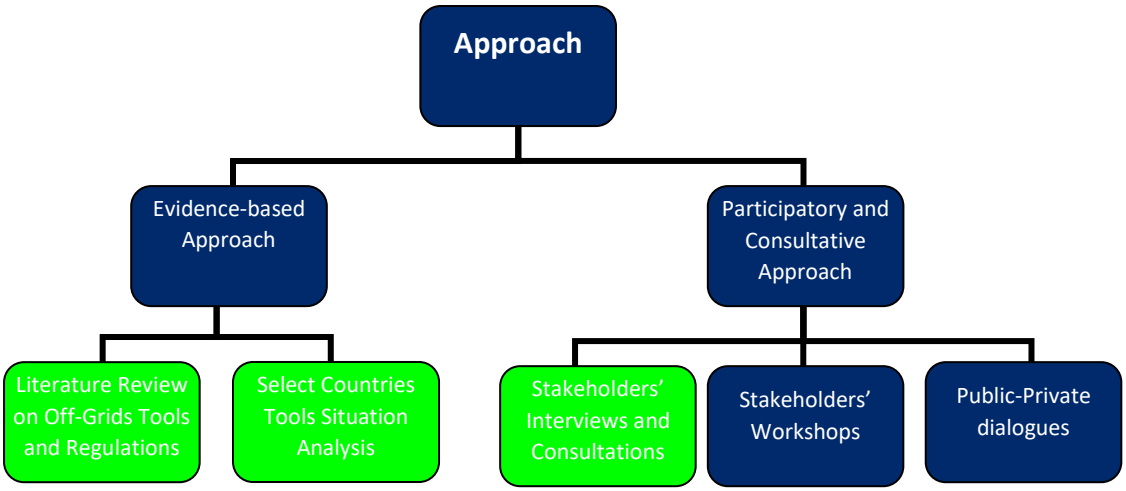
## 6.4 Project Outcomes

The expected project outcomes are (a) Streamlined tariff settlement processes that allow for investor-attractive off-grid energy tariffs, (b) Increased capacity building for African regulators on mini-grid tariff tools. (c) Increased engagement on investor friendly mini-grid tariff settlements between the public and private sector, (d) Successful facilitation of a clear debate on the interaction between tariffs, connection numbers and subsidy per connection.

# 7 Approach and Methodology

The following schematic diagram indicates the general approach that was applied to perform the activities of this stage of the project as appropriate.

Figure 3: Approach




The methodology entailed a combination of (i) evidence-based approach, and a (ii) participatory consultative approach.

*Evidence Based Approach*

In this approach, the project reviewed existing tariff settlement tools of five countries: Nigeria, Sierra Leone, Zambia, Tanzania, and Kenya. The tools were analysed using a standardised template of pre-defined salient features expected of a tariff tool. These salient features were informed by a literature review of regulatory practices, literature review, and from which a report that was concluded earlier in the performance of this project. The available policy, legislation, regulations of these countries were also reviewed in preparation to engaging their regulators during the stakeholders consultation stage that followed.

*The participatory consultative approach*

Initial consultation with key stakeholders was done according to the stakeholders' engagement plan that was prepared together with the inception report. The stakeholders' engagement plan identified project stakeholders, their roles and responsibilities as they relate to the project, how the project consulting team will interact and engage with them. Different stakeholders are to be engaged at different stages of the project delivery.

The consultation started with the regulators that own the tools analysed. After analysing each country's tool, the populated analysis template was shared with the respective country regulator followed by virtual meeting with economic regulation personnel from these regulators to review and confirm the analysis of their country's tool. The regulators validated the objectives of their tariff settlement tools, shared the challenges in using their tools and provided inputs to the solution.

In addition to the regulators of the countries whose tools were evaluated, the other stakeholders groups that were engaged include the developers of mini grids, the funders (donors and investors) of the mini grids, select countries' ministries of energy, the project working group and the project steering committee. Questionnaires were prepared, after literature review, for the various stakeholders that were consulted. The questionnaires were emailed to the respective stakeholders' contact persons followed by virtual interviews.

The following table summarises these stakeholders, their role in the project and how they were engaged:

Table 1: Stakeholder groups

| Stakeholder group | Role and responsibilities pertinent to the project | How the Project Team engaged them |
|---|---|---|
| 1. Regulators with existing tools | Users - to provide their tool for review, share lessons learned | Questionnaire emailed followed by virtual meetings |
| 2. Developers of mini grids | Users - to provide their experience using the tool, the process and bottlenecks | Questionnaire emailed followed by virtual meetings |
| 3. Donors and Investors in mini grids | Users - to provide their perspective on tariff tools to unlocking investment and experience using the tool, if any | Questionnaire emailed followed by virtual meetings |
| 4. Ministries of Energy | Influencers – Policy perspective on cost-reflective off-grid tariffs and regulations | Questionnaire emailed followed by virtual meetings |
| 5. Carbon Trust, AFUR, AMDA, PSC | Governance of the project throughout the project life cycle | Virtual presentations to the Working Group bi-weekly and PSC monthly |
| 6. Regional Organisations/Regional Economic Communities (REC) | Influencers of adoption that will be engaged once the improved tool is developed | Virtual meetings and Workshops |

The list of stakeholders from each group that were consulted is provided in the annex.

*Identification of gaps in the tariff settlement frameworks*

From the analysis of the five countries tools, supplemented by the literature review, learnings and inputs from stakeholders interviewed, the project identified baseline gaps in tariff settlement tools. In addition, there were proposals made for enhanced tariff settlement frameworks.

# 8 Review of Existing Tariff Settlement Tools

## 8.1 Overview

The project activity assessed tariff settlement tools of five country regulators, namely: Zambia, Tanzania, Kenya, Sierra Leone and Nigeria. The tool assessment covered the following areas: -

1. Tariff application requirements, approval processes and timelines
2. Tariff tools overview and inputs required
3. Tariff tools outputs – revenue requirement, tariff structures, and sensitivity analysis
4. Challenges/Lessons learned from using these tariff tools

These tariff tools assessments are provided in country comparative tables in annex 1 of this report. The following section provides the key features of each country's tool along with the gaps noted.

## 8.2 Zambia

### 8.2.1 Tariff application requirements, approval process and timelines

The Regulation of mini grid is anchored by the Mini grid Rules on Tariffs (2018) issued in terms of the Electricity Regulation Act. These rules are still evolving to align the mini grid framework to the new Energy Regulation and Electricity Acts that were enacted in the year 2019.

The mini grid sector is still in its infancy but has huge prospects for growth owing to the rising numbers of license applications being received by the Electricity Regulation Board (ERB) of Zambia. Three regulatory approaches are used by ERB depending on the size of the mini grid. In Category I are mini grids with capacity <100 kW for which the ERB adopts "Very Light Handed" Regulation. In Category II are mini grids with capacity from 101 to 1MW for which the ERB adopts Light Handed Regulations. In Category III are mini grids with capacity above 1MW for which the ERB adopts full regulatory approaches as per Electricity Act.

ERB developed an Excel based tariff tool for use on Category I and II mini grids to determine their tariffs. Currently, the ERB has licensed five (5) Mini grids mainly in the Rural areas. At the time of writing this report, ERB had not received a tariff application using the tool and therefore ERB has not had the experience of using this tool so far.

The Rules do not allow for portfolio tariffs applications and therefore a tariff application is done for individualised site tariffs. There are additional documents required to accompany a tariff application that are specified in the Rules. The Rules specify how the tariff application is processed upon receipt by ERB. The following table presents a summary of the regulatory approaches on tariff review and determinations.

Table 2: Summary of Zambia mini grids tariff regulations

| | 0-100 kW<br>Category I | 100 kW - 1 MW<br>Category II | > 1 MW<br>Category III |
|---|---|---|---|
| Tariffs | • No requirement for a formal tariff review<br>• Submit to ERB data on investment costs, O&M costs and sales<br>• ERB can only impose a tariff if within 20 Business Days of 'duly lodged' notification it finds tariffs unreasonable or 50% of | • By default, ERB does not commence a detailed tariff review for Category II Mini-Grids<br>• Developers are asked to provide 3-year tariff levels and escalation rates to be applied to Mini-Grid customers<br>• ERB uses an in-house modelling tool to check the reasonableness of tariff request<br>• Once tariffs are approved, they stay fixed, in real terms, for the duration of the "regulatory period" of 3 | • Tariffs regulated in 5-year regulatory periods during Periodic Reviews.<br>• Allowed revenues calculated according to the building-block approach (sum of depreciation, allowed revenues, operating and maintenance costs)<br>• Allowed revenues include working capital, collection debt and allowed losses<br>• The reasonable return is calculated based on weighted average cost of |

| | 0-100 kW<br>Category I | 100 kW - 1 MW<br>Category II | > 1 MW<br>Category III |
|---|---|---|---|
| | customers complain during implementation | years, not adjusted if changes are within a "materiality threshold";<br>• ERB may trigger a detailed tariff review for Category II Mini-Grids if it considers tariffs unreasonable. | capital, which sets cost of debt equal to the actual rate of financing<br>• Interim review can be triggered under exceptional circumstances, depending on a "Materiality threshold". |
| Tariff level | • Cost-reflective | • Cost-reflective | • Cost-reflective |
| Wholesale purchase price | • Unregulated but as specified in the license<br>• Mini-grid operators disclose the production price. | • By default, unregulated, mini-grid operators disclose the production price.<br>• If ERB triggers a price review, on the grounds that prices are unreasonable, then price set is either competition price (for solicited bids) or cost-plus methodology for unsolicited bids or when ERB considers competition ineffective. | • For solicited bids the price is the award price in the competitive process. If ERB considers competition insufficient it sets generation price according to Cost Plus<br>• For unsolicited bids the price is set according to tariff methodology. |
| Tariff structure | • Unregulated | • ERB sets principles only.<br>• Operators apply for tariff levels/service charges | • ERB sets principles only.<br>• Operators apply for tariff levels/service charges |

After making a decision on the tariff application, the ERB communicates the decision to the applicant. The Rules requires that, if ERB does not approve the tariffs applied for, it shall provide justifications why and propose an alternative tariff.

The mini grid tariff processing period for mini grid varies according to the category of the mini grid i.e. Category I, II or III. The cost of the tariff processing is borne by the Regulator from the levies collected from the electricity licensees.

### 8.2.2 Tariff tool overview and inputs

The tariff build up is founded on the Cost-of-Service principles to derive Revenue Requirement (RR). On this RR principle, the mini grid tariffs must allow the mini grid to recover the initial investment costs, prudently incurred operating and maintenance costs and earn a reasonable return on investment equivalent to the Weighted Average Cost of Capital.

All the variables that go into the calculation of the Revenue Requirement are inputs into the tariff tool. The tool is an MS Excel tool that comprises of a user guide/instructions and input tabs. The input tabs provide for the following:

- Capital expenditure – The capital costs are captured in an asset schedule itemised by useful lives and includes include costs and commissioning date. It is itemised for solar and hydro generation. Distribution infrastructure is itemised separately to show transformers, substation, poles and fixtures, and meters. The assets are valued at depreciated replacement cost
- Depreciation – the straight-line depreciation method is used as that is what is prescribed in the Rules. It does not provide for replacement of assets
- Working Capital – is added to the capital based on a formula (one month) of specific items
- Sources and amount of finance, amount of capital subsidies and recurrent subsidies
- Return on Investment as a Weighted Average Cost of Capital (WACC). The gearing ratio is set to reflect the actual financing structure of the regulated mini grid except where the gearing ratio is below 0.4 or above 0.7
- Tax rate – the corporate tax rate is for use to derive a pre-tax return on equity in the WACC formula
- Operating and Maintenance expenses (O&M) – electricity business O&M line items are provided to the regulator. Collection losses are not allowed because of prepaid meters
- Subsidies and unregulated income - are regarded as a negative cost
- Customer numbers and energy sales volume
- Customer categories - The tool allows developers to come with their own customer categories
- Capacity factors - The tool only considers the energy sold to ensure no excess capacity is loaded into the tariff
- Variables that are fixed – Some of these are disclosed in the tool. The tool assumes zero collection loses as it encourages prepaid metering. Network losses of 3% are allowed. The cost of equity (beta and MRP) elements as well as the capital structure are stated as above.

The tariff control period is 3 years for Category I and II mini grids whilst five (5) years is adopted for Category III mini grid and therefore the inputs above contain projections to enable calculation of proposed tariffs for over the control period.

### 8.2.3 Tariff tool outputs – revenue requirement, tariff structures and sensitivity analysis

**Revenue Requirement (RR)**: - as stated above, the cost-of-service principle is used to determine the mini grid revenue requirement. Under this principle, the revenue requirement (RR) is:

> ***RR = Depreciation + Return on Regulated Asset Base + Operating and Maintenance Expenses + Taxation.***

**Tariff Structures** – the ERB sets the tariff structuring principles only and the operators are free to propose their own tariff structures or service charges so long as such a proposal meets general principles outlined in the rule.

**Ability and willingness to pay considerations in tariff structures** – Category I &II developers conduct ability and willingness to pay surveys and rely on that. The tool does not allow inter-customer category subsidisation and does not consider the consumer's avoided of costs.

**Valuation when the main grid arrives** – The tool does not provide for valuation of the mini grid when the national grid arrives

**Sensitivity Analysis** – The tool does not provide for sensitivity analysis

### 8.2.4 Gaps, challenges and lessons learned from using the tariff tool

Table 3: Zambia Tool: Gaps, challenges and lessons learned

| Gaps, Challenges, and Lessons Learned |
|---|
| **Gaps in the tool** |
| The tool does not provide for annual adjustments of items like foreign exchange and inflation during the tariff control period. Instead, a variation that will lead to a tariff change of greater than 10% will require a new application to be prepared and submitted to the regulator. |
| The tool does not allow for portfolio tariff application and a tariff is tied to a site. |
| No specified sources of information (exchange rates, inflation rate) although the use of Central Bank information is encouraged |
| Ability and willingness to pay: The tool does not allow cross-subsidy between customer classes (Note: The three potential sources of subsidies are governments, donors, and cross subsidies between customers); Also, the tool does not provide for comparison of avoided costs for a true reflection of the cost of energy alternatives that mini grid customers face |
| The tool does not provide for a valuation of mini grid assets when the grid arrives. |
| The tool does not provide for sensitivity analysis |
| The tool does not provide for calculation and collection of comparative performance indicators that could be used to develop benchmarks |
| **Challenges and Lessons Learned** |
| The tool is not aligned to the new Energy Regulation Act and Electricity Act that were promulgated in the year 2020. The process of aligning the tool to the new Acts is ongoing |
| Generally, the industry has complained about the non-cost reflective tariffs in the Electricity sector |
| Tariff affordability- Most of the consumers in rural areas have seasonal income mostly during the post-harvest periods |
| Portfolio tariffs application is not allowed and that increases the risk of having a patchwork of individualised tariffs per site even where the sites are next to each other. Portfolio tariff approach will also reduce the regulatory burden of preparing a tariff per site |
| The public hearings are only for Category III. Although invited to participate, the public participation in tariffs making process is limited. For category I & II the mini-grid regulatory framework once implemented will remove the need for public consultations. |
| Unfavourable financing options - Lack of financing mechanisms for small players in the market (Most financial institutions are biased towards big entities) |

## 8.3 Tanzania

### 8.3.1 Tariff application requirements, approval process and timelines

The regulation of mini grid is anchored by the Electricity (Development of Small Power Projects) Rules, 2020.

The Energy and Water Utilities Regulatory Authority (EWURA) has developed an MS Excel tool for tariff settlement. The tariff tool for use by Very Small Power Producers (VSPP) with an installed capacity of: (a) less than 15kW at a single site selling power to at least thirty retail customers; or (b) between 15kW

and 100kW at a single site that either sells power at wholesale to a Distribution Network Operators (DNO) or at retail directly to a customer.

In addition to using the tool, there are additional documents required to accompany a tariff application and that includes the financial and technical information for period under which the tariff is applied. Whether or not to do a portfolio tariffs application is left to the discretion of the developer. But EWURA indicates that, ideally, every project needs to be considered separately due to different economics for each project due to differences in location.

In processing the tariff application, EWURA conducts public hearing meetings to collect comments from stakeholders. During the public hearings and in meetings with the regulator, the applicant is given an opportunity to respond/make clarifications before any adjustments are made to the tariff application.

After the regulator makes a tariff decision, the applicant is given a written decision known as a tariff order and the reasons for adjustments made to its tariff application to arrive at the regulator decision are clearly discussed.

The mini grid tariff processing period is about 90 days from the date the regulator receives a complete tariff application. The regulator bears all the costs of tariff processing including its public hearing meeting costs.

### 8.3.2 Tariff tool overview and inputs

The tool is an MS Excel model with a user guide. The user guide includes tariff application guideline for regulated utilities in the electricity and natural gas subsectors, 2017.

**Inputs**

All the variables that go into the calculation of the Revenue Requirement are inputs into the tariff tool. The input tabs provide for the following:

- Capital expenditure – The capital costs are captured in an asset schedule itemised by useful lives. Interest during construction is capitalised. The assets are valued at historical cost
- Depreciation – the straight-line depreciation method is used
- Working capital allowance is considered under Regulatory asset base
- Sources and amount of finance, amount of capital subsidies and recurrent subsidies
- Return on Investment as a Weighted Average Cost of Capital (WACC).
    - Cost of equity - the capital asset pricing model (CAPM) is used for deriving cost of equity. The return on equity is capped at 18.5%
    - Cost of debt - the interest of specific debt is considered, but should not be more than 9%
    - Capital structure – ratio of 70:30 in Debt to Equity is adopted
- Tax on returns on investment is considered after excluding all prudent costs from revenue at a tax rate of 30%
- Operation and maintenance costs are considered to arrive at revenue requirement. After review of all costs, only the prudent costs are considered. The O&M is not to exceed 8% or capex
- Subsidies - are a reduction to the revenue requirement
- Customer numbers and energy sales volume
- Customer categories - The tool allows developers to come with their own customer categories
- Capacity factors for each technology are predetermined. Capacity degradation is also capped at 0.5% per annum. Mini grids are required to attain full capacity within 4 years of operations.

Accordingly, the installed capacity should not exceed its projected demands within 4 years of operations.

- Variables that are fixed – Some of these are disclosed in the tool. The cost of equity is capped as well as the capital structure are stated as above.

The tariff control period is 3 years and therefore the inputs above contain projections for the three-year period to enable calculation of proposed tariffs for 3 years.

### 8.3.3 Tariff tool outputs – revenue requirement, tariff structures and sensitivity analysis

**Revenue Requirement:** The tariff build up is founded on the Cost-of-Service principles to derive Revenue Requirement (RR). On this principle, the mini grid tariffs must allow the mini grid to recover the initial investment costs, prudently incurred operating and maintenance costs and earn a reasonable return on investment.

> ***RR = Return of capital (depreciation) + Return on capital (WACC*RAB) + Operating costs + Taxes pre-tax WACC***

**Customer Categories:** Mini grid customers categories depend on the applicant proposed groups, there are no specific or standard groups prescribed in the tool.

**Tariff Structures:** The actual power sold is considered in the determination of tariffs. Tariff structures differ from one developer to another depending on their metering facilities. In structuring tariffs, developers may be allowed to do inter-customer category tariff cross-subsidies.

**Ability and Willingness to Pay**: Avoided costs are not considered in assessing the ability to pay by mini grid customers

**Sensitivity Analysis:** The tool enables an input-output and output-input sensitivity analysis. For instance, one can enter tariff to get subsidy or enter a target IRR to get a tariff.

**Valuation when the grid arrives:** The Regulations provides options of what should happen when the grid arrives but there is no provision for a valuation in the tool

### 8.3.4 Gaps, challenges and lessons learned from using the tariff tool

Table 4: Tanzania Tool: Gaps, challenges and lessons learned

| Gaps, Challenges, and Lessons Learned |
|---|
| **Gaps in the tool** |
| A directive issued by the Ministry of Energy means the Very Small Power Producers (VSPP) tariffs are currently capped at national utility tariff and therefore the tool is not used |
| The tool does not provide for portfolio tariff application. But, while the tool itself does not provide for portfolio tariff application, the regulator allows developers to modify the tool by including a separate sheet that outlines and sums up individual village inputs into portfolio outputs |
| The information (inflation, exchange rate, cost of debt) sources are not specified in the tool. In practice, the regulator requests developers to add an additional tab to the tool to justify all inputs (making reference to sources of the data entered) |
| Although the regulations do not require the mini grid tariff structures to be similar to that of the national utility, a political directive required the mini grids to charge the same tariff as the national utility |
| The tool does not have a provision for a valuation when the grid arrives |

| Gaps, Challenges, and Lessons Learned |
|---|
| It does not provide for calculation and collection of comparatives performance indicators that could be used to develop benchmarks |
| **Challenge and Lessons Learned** |
| The government directive to all VSPPs to charge the national grid uniform tariff has left these VSPPs charging non cost reflective tariffs which has eroded these VSPPs economic viability |
| The model contains complicated links that are difficult to follow. The model should be simple and straight forward to ease the tracing process |
| The possibility to edit the tool (and tool formulas) may be viewed as a challenge in itself, considering that it reduces visibility by the regulator on what formulas are used. |
| Limited financing options for developers due to low tariffs |

## 8.4 Kenya

### 8.4.1 Tariff application requirements, approval process and timelines

The regulation of mini grids is anchored by the Energy Act (2019); Draft Energy (Mini-Grid) Regulations (2021); Internal Procedures and Guidelines for Regulating Mini-Grids (2018).

The Energy and Petroleum Regulatory Authority (EPRA) has an MS Excel tariff tool for use by all mini grids of less than 1MW installed capacity.

In addition to using the tool, there are additional documents, such as the mini grid feasibility studies, required to accompany a tariff application as specified in the Draft (Mini Grid) Regulations (2021).

In processing the tariff application, EPRA undertakes a detailed analysis of the tariff application model and feasibility studies submitted by the developer followed by a public stakeholder consultation. The regulator deliberation on the tariff application is open to the public.

After the regulator makes a tariff decision, a gazette notice is published to notify the public of the approved tariffs. The regulator communicates to the developer in writing the justification for adjustment of the tariff applied for by the developer at least fourteen (14) days before publication.

Batch (Portfolio) tariff processing is done for developers with varied sites on condition that all sites' stakeholders agree to the proposed tariffs during stakeholder engagements.

The mini grid tariff processing period is about 60 days from the date the regulator receives a complete tariff application. The regulator bears all the costs of tariff processing.

The mini grid tariff tool has enhanced regulatory efficiency by ensuring consistency, predictability, comparability. The regulator has approved over 10 mini grid tariffs using the standard tariff tool. The regulator is receiving average of 2 to 3 new tariff applications every month using the tool.

### 8.4.2 Tariff tool overview and inputs

The tool is an MS Excel model with instructions and a user guide. The user guide explains each element contained in the tariff tool tabs. The tool provides for all renewable technologies and a provision for a genset back up.

**Inputs**

All the variables that go into the calculation of the Revenue Requirement are inputs into the tariff tool. The tool has Capital Cost Details of the Mini-Grid and Tariff Inputs. The input tabs provide for the following:

- Capital Costs: The Capital costs are itemised, based on useful life which informs the depreciation years. Interest during construction is capitalised and form part of regulated asset base. The assets are valued at historical cost basis less depreciation
- Depreciation: The tool provides for two methods of depreciation, straight line and units of outputs, for the user to choose one. The straight-line method is the most used.
- Working capital: There is a provision for working capital in the tool, but the number of days is at the discretion of the regulator. The working capital is considered under Regulatory asset base
- Sources and amount of finance, amount of capital subsidies and recurrent subsidies
- Return on Investment as a Weighted Average Cost of Capital (WACC).
    - Cost of equity - the capital asset pricing model (CAPM) is used for deriving cost of equity. The return on equity is capped at 18% pre-tax.
    - Cost of debt - Cost of debt is the actual cost of debt less tax (due to tax shield on interest payments)
    - Capital structure – ratio of 70:30 in Debt to Equity is adopted
- Tax on returns on investment is considered after excluding all prudent costs from revenue at a tax rate of 30%
- Operation and maintenance (O&M) costs- only prudently incurred costs for the provision of the service are allowable. Developer enters a proportion (in %) of the expenses that are to be escalated on an annual basis.
- Subsidies - Capital subsidies are deducted from the capex (don't earn a return), recurrent subsidies are deducted from the O&M costs
- Customer numbers - Customer connections are used in re-calculating the fixed charges per customer per month and capacity expansion planning
- Customer categories – Generally four categories are considered, residential, commercial, institutions, and street lighting
- Capacity factors is used to calculate the amount of energy generated by a plant as it shows the no of hours the resource is available. The tool assumes that the design is optimal and will be fully utilised. Tariffs are based on generated energy and not demand and hence idle capacity doesn't affect the tariffs as the models assumes all generated energy is dispatched. There is a provision for capacity degradation annually.
- Variables that are fixed – these are in the internal guidelines used by the regulator and are largely unknown to the first-time applicants.

The tariff control period: The first review is done after one year, after which three- year reviews are made. The tool provides for automatic adjustments for inflation within the future projections, but not exchange rate or fuel costs.

### 8.4.3 Tariff tool outputs – revenue requirement, tariff structures and sensitivity analysis

**Revenue Requirement:** The tariff build up is founded on the Rate of Return (Cost-of-Service) principles to derive Revenue Requirement (RR). On this principle, the mini grid tariffs must allow the mini grid to recover the initial investment costs, prudently incurred operating and maintenance costs and earn a reasonable return on investment.

| |
|---|
| ***RR = (Regulate Asset Base (RAB) * Rate of Return (RoR) + Operating & Maintenance (O&M) + Depreciation (D) + Taxes (T)*** |

Non-tariff revenues are deducted from the revenue requirement

**Customer Categories:** Customers are categorised based on their energy consumption/ load profile and cost of service costs allocation. Customer Categories in the model are: Households, Institutions, Business and Anchor.

**Tariff Structures:** The tariff structure considered and approved is at the discretion of the Authority. The mini-grid tariff structure is not required to be similar to that of the national utility. Developers are flexible to introduce inter-customer tariff cross subsidies to ensure social policy objectives are met.

**Ability and Willingness to Pay**: The tariff comparator in willingness and ability to pay is the avoided cost tariff, mostly comparing with kerosene, which is the mostly used alternative

**Sensitivity Analysis:** A user is allowed to increase or decrease input parameters to see how it would change tariffs. The user can create a best-case scenario, expected case scenario and worst-case scenarios. Results of the multiple scenarios may be compared using the "copy" and "paste special - values"

**Valuation when the grid arrives:** in the tool valuation is done based on the remaining depreciated value of the assets, plus any revenue the Mini-Grid Operator is owed by consumers but has not yet received up until the date of the transfer of assets.

### 8.4.4 Gaps, challenges and lessons learned from using the tariff tool

Table 5: Kenya Tool: Gaps, challenges and lessons learned

| Gaps, Challenges, and Lessons Learned |
|---|
| **Gaps in the tool** |
| Variables that are fixed are not disclosed on the tool - The assumptions on capital structure, return on equity, capacity factor, are in the internal guidelines used by the Regulator and are largely unknown to first time applicants |
| Tariff control period - the first tariff review is done after one year, which is too short. |
| The number of days of working capital is at the discretion of the regulator which leaves room for uncertainty |
| Sources of information are left to the discretion of the developers but subject to the review by the regulator. This also leaves room for uncertainty |
| The applicant does not have discretion to propose tariffs structures. The tariff structure considered and approved is at the discretion of the Authority. Currently the conventional kWh charge is preferred by the regulator as it is the same structure allowed for the national utility There is not much flexibility on customer categories |
| It does not provide for calculation and collection of comparative performance indicators that could be used to develop benchmarks |
| **Challenges and Lessons Learned** |
| Assets are depreciated in line with their useful life. However, there is weakness of the model as it sums up the depreciation values for all assets and takes that as the annual depreciation to feed into the Revenue requirements number. The challenge is with assets whose life is lower than useful life of the plant. |
| How to treat grants/ subsidies in tariff tool – the tool does not seem to pull the subsidies received in early years to later years. To address this challenge needs for continuous assessment and improvement of the tariff tool so that it captures all investment dynamics for sustainable mini-grid development |
| Difficulty in assessing prudence/efficiency of costs due to lack of adequate data for benchmarking. This will require undertaking benchmarking analysis to ensure efficient costs are determined |

| Gaps, Challenges, and Lessons Learned |
| --- |
| There are no clear performance indicators to compare various mini grids. This will also require undertaking benchmarking analysis to determine efficient costs |
| Conflicting objectives (affordability vs operational efficiency vs fair return to mini grid developers) in determining RAB |

## 8.5 Sierra Leone

### 8.5.1 Tariff application requirements, approval process and timelines

The SLEWRC tool is an MS Excel tariff tool applicable to full mini grids with more than 100kW aggregated installed capacity. In addition to using the tool, the additional documents required to accompany a tariff application is prescribed in Regulation 59 and listed in Tariff Approval Application Form as a requirement.

In processing the tariff application, SLEWRC publishes the application in newspapers and government gazette, conducts a prudency test followed by community engagement. During the community engagement, the consumers affected by the tariff are given an opportunity to be heard and the applicant makes a presentation in this meeting to support of its application. The applicant is given an opportunity to respond to any questions and clarifications sought.

After the regulator makes a tariff decision, the regulator publishes the decision in government gazette, government newspapers, and the commission's website. The regulator communicates the decision to the applicant in form of a Decision. In case of a rejection, the regulator communicates the acceptable rates and the reasons for these rates at the time the decision is communicated and will further provide alternative methods/model calculation to the operators.

With respect to batch or portfolio tariff processing, it is possible to have one tariff for multiple of locations. However, the tariff varies by the developer based on the regions and costs they are incurring.

The mini grid tariff processing period is between 30 days and 60 days from the date the regulator receives a complete tariff application. The regulator bears all the costs of tariff processing.

### 8.5.2 Tariff tool overview and inputs

The tool is an MS Excel model with an instructions tab within the tool. There is no separate user guide. The tool provides for solar and a genset back up.

The tariff tool is under pinned by the Cost of service (Rate or Return Methodology) methodology hence the tool calculates the tariff from Revenue Requirement that is a summation of: Operational Cost + Depreciation + Return + Performance Related Margin.

The Nigeria tool and the Sierra Leone tool are remarkably similar in all respects including the 5-year MYTO tariff.

**Inputs**

All the variables that go into the calculation of the Revenue Requirement are inputs into the tariff tool.The input tabs provide for the following:

- Input Assets/Asset Definitions –
    - Capital costs- the assets are grouped according to useful lives/depreciation years and common usage characteristics. The assets are valued at historical cost. The % of assets notfunded by grant is inserted on the financing column

    - There is no provision for interest during construction
    - Depreciation - The annuity method is used.
    - Working capital - There is no provision in the tool for working capital
- Input Various
    - Return on Investment as a Weighted Average Cost of Capital (WACC) - The target rate of return is entered as one value, so there is no provision for cost of debt, cost of equity or capital structure. Each developer gets a different, rate of return.
    - Tax on returns on investment - There is no separate line for tax. It can only be presumed that the rate of return is pre-tax
    - The tool has a Performance Related Profit Margin – as a SLL input
- Input Costs
    - Operation and maintenance costs- A complete listing of O&M line items is provided. Thereis a provision for escalation as there is a MYTO tool that has been developed. There is a prudence test of costs andif they are outside the range, adjustments are made.
- Input Demand
    - Customer numbers – the MYTO tool does consider year on year growth of customers/connections.
    - Customer categories – developers propose their own customer categories
- Capacity factors - developers ensure customers register before they go ahead to instal the capacityin a particular site. Where developers faced challenge of excess capacity, they moved the installation to another location and left the place for a smaller operator-The tool only considers demand and therefore no consideration of idle capacity.
- Variables that are fixed – it does not specify variables that are fixed.
- Central Bank average exchange rate for the year is used. The developers are aware on this sourceof exchange rate information
- Tariff Calculation
    - The tool has a reserve adjustment account – as a % input in Tariff Calc

Currently the tariff control period is for 5 year (MYTO) with provison for annual adjustment.

### 8.5.3 Tariff tool outputs – revenue requirement, tariff structures and sensitivity analysis

**Revenue Requirement:** The tariff build up is founded on the Rate of Return (Cost-of-Service) principles to derive Revenue Requirement (RR). On this principle, the mini grid tariffs must allow the mini grid to recover the initial investment costs, prudently incurred operating and maintenance costsand earn a reasonable return on investment.

***Revenue Requirement = (rate of return x RAB) + D +O&M + T + (Performance Related Profit Margin (SLL/kWh) * Electricity sold)***

Grants for operational costs are subtracted from allowable revenues. Grant funded capital assets areremoved from RAB in Inputs Assets tab under % financing column

**Customer Categories:** The developers are allowed to enter their own customer categories in Input Demand tab.

**Tariff Structures:** The Regulations(57(2)(b) prescribes options of tariff structures to be (a) conventional kWh tariffs, (b) flat rate tariffs, (c) power tariffs or (d) a combination of the above. Tariffcalc tab has input for “Cost factor” and that can be used to do inter-customer category cross subsidies. The tariff outputs are provided in Tariff Calc tab as Tariff in SLL/kWh (i.e., the

conventional kWh tariffsstructure)

**Ability and Willingness to Pay**: Before implementation, the developer conducts an ability and willingness to pay study. It is not clear if the avoided cost is considered in this analysis.

**Sensitivity Analysis:** The tool does not have a scenarios analysis functionality

**Valuation when the grid arrives:** There is no provision in the tool for valuation of the mini grid.

### 8.5.4 Gaps, challenges and lessons learned from using the tariff tool

Table 6: Sierra Leone Tool: Gaps, challenges and lessons learned

| Gaps, Challenges, and Lessons Learned |
|---|
| **Gaps in the tool** |
| The tool does not specify the variables that are fixed |
| There is no provision in the tool for working capital |
| There is no separate line for tax in revenue requirement calculation. It can only be presumed that the rate of return is pre-tax |
| The applicant does not have discretion to propose tariffs structures as that is prescribed in the Regulations. |
| No valuation of mini grid when the main grid arrives is provided is for in the tool |
| It is not clear if the avoided cost tariff is considered in the ability and willingness to pay analysis |
| It does not provide for calculation and collection of comparatives performance indicators that could be used to develop benchmarks |
| The tool does not provide for scenario analysis |
| **Challenges and Lessons Learned** |
| Customers using appliances complained of tariffs becoming a burden, but it was realised that this was because of these customers' choice of appliances. To address this, the regulator conducts customer education where the customers are advised on a choice of appliance to manage their consumption |

## 8.6 Nigeria

### 8.6.1 Tariff application requirements, approval process and timelines

The regulation of mini grids is anchored on the Nigerian Electricity Regulatory Commission (NERC) Regulations for Mini-Grids 2016 issued in terms of S.96 of the Act (EPSR Act 2005). The annexure to these Regulations contains the multi-year tariff order (MYTO) tool.

The NERC tool is an MS Excel tariff tool applicable to mini grids with installed capacity of between 100kW and 1MW. NERC has also developed online tools for permit applications plus online tariff application. The MYTO tool is intended to be cost plus tool, i.e., provides for all efficient costs plus a return on investment. In addition to using the tool, other information that needs to be submitted with a tariff application include: an Agreement with community showing the community has agreed to pay the tariff applied for; a title of land where the project will be put; ESIA from Ministry of Environment.

The tariff application is submitted online on NERC website filling all information required as well as uploading the populated MYTO model. The developer applies to the regulator for approval of the tariff in the MYTO that the developer has agreed with the community. When NERC receives the application, it reviews the tariff model, assesses the costs to see if what they have proposed is reasonable. If the costs are too high, the developer approaches the Rural Electrification Agency (REA) for grants, provided either through the rural electrification fund (REF) or the Nigerian electrification project (NEP) financed by World Bank (WB), to subsidise the tariffs. It should be noted that NERC is not part of the

consultation between the community and the mini grid developer that culminates in the agreed tariff for which the developer is seeking approval.

With respect to batch or portfolio tariff processing the developer must have a tariff for each site. However, if the developer wants an average tariff they can have it, but any compensation when the grid arrives (from DisCo) is assessed for each individual site and not on a portfolio basis.

The mini grid tariff processing period is about 30 days from the date the regulator receives a complete tariff application. The cost of submitting/processing the tariffs is borne by the mini-grid operators and is part of their development costs.

### 8.6.2 Tariff tool overview and inputs

The tool is an MS Excel model with an instructions tab within tool. The tool comes with an embedded user guide and comments (explanations) and regular trainings are held to familiarise users with the tool. The tool provides for solar and a genset back up mini grid system. While solar is the most popular in the country due to its abundance, the tool is set up to service all type of renewable energy system. Submissions were made by developers on biomass especially to argument solar generation is the Southern part of the country where biomass resource is in abundance. The Nigeria tool and the Sierra Leone tool are remarkably similar.

The tariff tool is under pinned by the Cost of service (Rate or Return Methodology) methodology hence the tool calculates the tariff from Revenue Requirement that is a summation of: Operational Cost + Depreciation + Return + Performance Related Margin + Payments to DisCo.

**Inputs**

All the variables that go into the calculation of the Revenue Requirement are inputs into the tariff tool. The input tabs provide for the following:

- Input Assets/Asset Definitions – The asset groupings used are: Generation Assets, Project Development Costs, Initial Operating Costs, Distribution Assets, Customer Connections, and, Company Wide Costs
    - Capital costs- the assets are grouped according to useful lives/depreciation years and common usage characteristics. The assets are valued at historical cost. The % of assets not funded by grant is inserted on the financing column
    - Interest during construction is not expected and hence there is no provision for it
    - Depreciation - The annuity method is used
    - Working capital - The operators use smart meters and prepaid, hence no working capital
- Input Finance
    - Return on Investment as a Weighted Average Cost of Capital (WACC) - Cost of debt is explained as the “expected” debt interest rate; For registered projects, the applicable cost of equity is prescribed in the Regulations as expected debt interest rate + 6%. Developers can choose to either negotiate the tariff directly with the communities (and the restriction as in the text applies), or they use the MYTO tool, in which case the cost of equity is not prescribed by regulation.
    - Tax on returns on investment - There is no separate line for tax. It is assumed developers enjoy pioneer status at this early stage of development of the market and might therefore pay no tax. When the tool is being reviewed after the expiration of pioneer status, tax will be captured. However, customers pay value added tax of 7.5% with every purchase of electricity units which will be remitted by the developer to the appropriate tax office
    - The tool has a Performance Related Profit Margin – as a local currency per kWh input

- Input Costs
    - Operation and maintenance costs- The operating expenses are grouped into "changing operational costs" versus "constant operational costs". The model allows the user to escalate some costs.
    - Re-interconnection costs paid to the DisCos as a Usage Fee charge net of power sold to the DisCos is input in the Insert DisCos standalone tab that is then added to allowable revenues in Tariff Calc tab
- Input Demand and Capacity factors
    - The tool does not consider design capacity or capacity factors. Instead, NERC looks at the tariff model to estimate the optimal power supply and modify to remove any excess capacity. If the tariff is too high, the fewer the subscribers likely to sign up. The rural electrification agency also checks to ensure no excess capacity before giving a subsidy.
    - There is no adjustment for idle capacity in the early years where the tool uses the total energy consumption (kWh/year) and the full costs of the plant in the tariff calculation
    - In total energy consumption calculation, the model uses the customer numbers growth and growth in demand per customer
- Variables that are fixed –
    - the tool does specify some (but not all) of the variables that are fixed.
- Sources of information –
    - the Central Bank of Nigeria (CBN) is the main source of information. Interest rate is from project's own term sheet

The tool is a 5-year MYTO which, in theory, means anticipated future changes in the tariff (over the period of five years) are already accounted for in the MYTO at the time of tariff application. The Regulation allows review by showing the cause (could come from community or developer), otherwise the developers are supposed to hold the tariffs at the same level for 5 years. The tool does not provide for automatic adjustments of foreign currency depreciation.

### 8.6.3 Tariff tool outputs – revenue requirement, tariff structures and sensitivity analysis

**Revenue Requirement:** The tariff build up is founded on the Rate of Return (Cost-of-Service) principles to derive Revenue Requirement (RR). On this principle, the mini grid tariffs must allow the mini grid to recover the initial investment costs, prudently incurred operating and maintenance costs and earn a reasonable return on investment

| ***Revenue Requirement = Operational Cost + Depreciation + Return + Performance Related Margin + Payments to DisCo*** |
|---|

Non-tariff revenues such as the connection charge is subtracted from the connection costs, the capital subsidies are deducted from the regulated asset base

**Customer Categories:** The tool leaves the customer categorisation to the user

**Tariff Structures:** NERC allows options of tariff structures so long as the structure enables the developer to collect their revenues. The following tariff structures are used: Average Pay as you go (PAYG) which same as energy-based tariff; Average flat rate tariff (Revenues/No. of customers), Average Day Time Tariff vs Average night-time tariff (ToU). The mini grid tariff structures are not compelled to be similar to national utility tariff. Developers are allowed to do inter-customer category tariff cross-subsidies – A base tariff is determined, and all other tariffs are a % of that base tariff.

**Ability and Willingness to Pay**. It is not clear if the avoided cost tariff is considered in this analysis.

**Collection and calculations of comparative performance indicators:** The tool provides for benchmarks of costs which the Commission applies to ascertain and compare similar mini grids for outliers

**Sensitivity Analysis:** The tool does not have a scenarios analysis section

**Valuation when the grid arrives:** At the arrival of the main-grid (DisCo networks) the permit holder is entitled to a compensation equivalent to the depreciated value of the mini-grid investment plus one year revenue.

### 8.6.4 Gaps, challenges and lessons learned from using the tariff tool

Table 7: Nigeria Tool: Gaps, challenges, and lessons learned

| Gaps, Challenges, and Lessons Learned |
|---|
| **Gaps in the tool** |
| The tool does not specify all the variables that are fixed, e.g., the allowed technical losses |
| There is no provision in the tool for working capital |
| It does not provide for automatic adjustment of foreign currency depreciation during the control period |
| The tax is not explained in the tool. |
| It is not clear if the avoided cost is considered in the ability and willingness to pay analysis |
| The tool does not provide for sensitivity analysis to test various inputs and outputs |
| The tool does specify some (but not all) of the variables that are fixed. |
| **Challenges and Lessons Learned** |
| The communities are not conversant enough to interrogate their tariffs. The feasibility studies stage requires developer to hold consumer enlightenment and form a Power Consumer Committee which is supposed to be enlightened members of the Community. The Committee can also consult/contact the Commission for clarification and explanation on the tariffs and other issues concerning the mini grid. |
| The regulator does not have information to use to assess whether costs are reasonable.<br>To address this challenge the regulator plans to conduct a market survey to get a range of equipment costs from where they are coming as an information guide on cost of these equipment to be able to compare<br>It is also recommended that AFUR should come up with a joint project to compile a compendium of data from various projects that regulators can use to know level of efficiency, level of tariffs, etc |
| Some places where these developers work are very remote without communication network which hinders web-based tariff applications. To address this challenge, the regulator should provide online application tools and online monitoring system |
| The regulatory environment is onerous, for example the ESIA costs are very high. To address this challenge, the Commission, the Federal Ministry of Environment and other stakeholders reviewed the ESIA for mini-grid and substantially reduce the cost to make it reasonable considering the capacities of mini grids and their environmental requirement |

## 8.7 Comparison of gaps found in each analysed country tariff tool

The following table provides a comparative summary of the gaps found in the country tools analysed.

Table 8: Comparison of gaps found in each analysed country tariff tool

| Gap | Zambia | Tanzania | Kenya | Sierra Leone | Nigeria |
|---|---|---|---|---|---|
| The tool does not provide for annual adjustments of items like foreign exchange within the tariff control period | Yes | | | | Yes |
| The tool does not allow for portfolio tariff application and a tariff is tied to a site | Yes | | | | |
| No specified sources of information (exchange rates, inflation rate, etc) | Yes | Yes | Yes | | |
| The tool is not clear on how the avoided cost tariff is considered in the ability and willingness to pay analysis | Yes | | Yes | Yes | Yes |
| The tool does not provide for a valuation of mini grid assets when the main grid arrives. | Yes | Yes | | Yes | |
| The tool does not provide for sensitivity analysis | Yes | | | Yes | Yes |
| The tool does not provide for calculation and collection of comparative performance indicators that could be used to develop benchmarks | Yes | Yes | Yes | Yes | |
| The tool does not specify all the variables that are fixed | | | Yes | Yes | Yes |
| The tool does not have a provision for working capital | | | | Yes | Yes |
| The tool does not show tax in revenue requirement calculation. | | | | Yes | Yes |
| The tool does not allow flexibility in tariff structuring | | Yes | Yes | Yes | |
| The tool does not allow multi-year tariff application | | | | | |

**Key: Yes, means the tool has the gap.**

# 9 Stakeholder consultations

## 9.1 National Regulators

As explained in the methodology, the regulators were consulted as part of the evaluation of their respective tariff tools. The regulators' feedback is therefore captured within the analysis of the tools provided in the preceding section

## 9.2 Mini Grid Developers

### 9.2.1 Introduction

After assessing the tariff tools of the respective regulators, the project activity consulted with the developers to obtain their perspectives of mini grid tariff settlement tools in the markets that they are operating or considering operating. Some of the developers operate in the countries whose tools were evaluated and therefore provided practical perspectives of these tariff settlement tools. The consultations with developers covered the following areas: -

1. Countries of operation and factors influencing choice of countries
2. Experience and lessons from using the regulator's tariff tools
3. Proposals for streamlining tariff settlement and developing an enhanced tariff tool

The seven (7) developers consulted collectively have mini grid projects operating or under development in eight (8) sub-Saharan countries in Eastern, Southern, Western and Central Africa. The countries are Tanzania, Kenya, Uganda, Zambia, Nigeria, Sierra Leone, Benin, and Cameroon. Some of these developers operate in more than one of these countries and therefore they have experienced country to country variations in mini grid regulatory practices and tariff settlement tools.

The developers identified various factors that are important in evaluating markets they choose to develop their mini grid projects. These factors include: the existence of a mini grid regulatory framework in the country; electrification status wherein government wants to use mini grid as a driver of rural electrification; potential market size of the mini grid consumers; availability of funding support to mini grid projects development; Political environment/ease of doing business in a country.

### 9.2.2 Summary: Experiences and lessons from using the tools and improvements proposed

Various questions were posed to the developers to assess their respective experiences and lessons learned from using the regulator's tariff tools in the countries they operate as well as to elicit proposals for streamlining tariff settlement and developing an enhanced tariff tool.

Some of the mini grid developers interviewed started mini grid projects in Africa from the year 2015. These developers recognise that a lot of progress that has been made in the mini grids tariff setting since then. Despite this progress, developers indicated that there are still concerns to be addressed to improve the tariff settlements. It was also reported that tariff settlement varies from country to country and therefore developers' concerns about current tariff settlement frameworks vary from country to country. While some of the proposals are specific to the tariff settlement tools, others are general to the mini grid regulatory environment. The following are some of these experiences and proposals:

Table 9: Developers' concerns about current tariffs settlement, tools and improvements proposals

| |
|---|
| Markets and the political establishment want lower tariffs. But these lower tariffs are not cost reflective, and the push for a lower tariff does not come with subsidy support. The subsidy burden is left to the developer. |

The proposal is that the drive for lower tariffs should be backed by commensurate subsidies to balance affordability by consumers with mini grid sustainability. It is important to get governments buy-in on tariff settlement frameworks.

At times there is a disconnect between the promulgated regulations and ad hoc political directives. When promulgated regulatory framework are changed abruptly without consultation through such directives, and after investments are made, they erode mini grids economic viability.

The proposal is that policy certainty and policy stability is required once investors make commitments based on existing frameworks to protect mini grid viability. The process of changing regulatory frameworks should be clear and changes should not adversely existing investments.

The regulations generally provide for timelines for the tariff processing which ranges between 30 days and 90 days in the countries whose tariff tools were reviewed. However, experience shows that one of the key challenges with regulators is the bureaucratic process that slows down the processes such that the tariff approvals are not always being made within those timelines prescribed in the regulations.

The proposal is to address the bottlenecks, including providing training on use of the tariff tool.

The regulated electricity supply industry is by nature complex and its regulation is a specialised discipline. It is inherent that the tariff regulatory process and tools are unfamiliar to new entrants. It was therefore observed that some of the tools look complicated to some users and need a lot of information to get the tariff output.

The proposal is to balance between the level of details requested by regulators in tariff tool and the developers' preferred broad information categories. The tool also needs to balance between simplicity and accuracy-the more functionalities required, the more complex and bulkier the tool becomes.

Challenges specific to the tariff tools include: some tools do not disclose all the inputs that are fixed; the cost benchmarks to use by the regulators for assessing costs are lacking leaving room to argue on every variable because there are varying assumptions on the cost inputs; foreign exchange rate depreciation adjustment is not mitigated in multi-year tariff orders (MYTO) that require tariffs to remain the same over the tariff control period; some tariffs control period is one year which is too short and risky for investors; there is no flexibility given to the developers in tariff structuring; lack of clarity on how compensation is calculated when the grid encroaches the mini grid service territory; some tools do not provide for portfolio tariff applications because some regulations prescribe individualised site tariffs.

The proposals to address these tariff tools specific limitations are: The tools should disclose the inputs that are fixed; The regulators should develop benchmarks of costs but at the same time recognize that each project is different. The tool could have some outputs that will be collected for benchmarks, e.g., Capex per kW, Opex per kW, Opex per customer, etc. The tool should allow for adjustment of uncontrollable variables like foreign exchange depreciation over the tariff control period; Structure the tool for a control period of at least 5 years MYTO with an option for life cycle tariffs; regulators should allow developers flexibility to do their own tariff structuring but just ensure that consumers are not being exploited; Valuation of the mini grid asset should be provided for in the tool for use in compensation when the grid arrives; the tools should provide for portfolio tariff applications for use where regulations allow. The tool should have a user guide and regulators need adequate capacity to use the tool.

| Other proposals |
|---|
| With respect to plant sizing and excess capacity, it is a real challenge when forecast demand does not materialize after the system has been sized and installed, leaving excess capacity. The demand is lower due to fewer connections than forecast or the consumption per customer is lower than forecast. In some cases, consumption is also seasonal. Cost reflective tariffs are distorted when there is excess capacity. The regulators are right in not allowing the connected customers to pay for excess capacity by using the installed capacity in the tariff calculation. Developers are learning and improving on the way of sizing, and some are using modular designs to start small and increase capacity as consumption grows. The downside of this modular approach is that the economies of scale in capex is lost.<br><br>A final aspect requested that can be added as a sensitivity analysis is for the tariff tool to show the gap between the mini grid cost reflective tariff, a standardised national mini grid tariff (rural tariff) and the subsidy required. This subsidy could be funded by donors and governments. |

### 9.2.3 Specific Questions and Responses

The following is synthesis of responses obtained to specific questions posed to the developers. The verbatim responses from these consultations with developers are provided in Annex 2 of this report.

***Developers' specific concerns about current tariff settlement frameworks in countries of operation***

| Experiences and Lessons | Proposals on Improvements |
|---|---|
| • All markets want lower tariff, but these lower tariffs are not cost reflective, and the push for a lower tariff does not come with subsidy support. The subsidy burden is left to the developer. | • The drive for lower tariffs should be backed by commensurate subsidies to balance affordability by consumers with mini grid sustainability. |
| • There is a disconnect between the promulgated regulations and ad hoc directives. Instances where investors make decision on a certain framework which then changes overnight without consultation, after investments are made, erode mini grids viability | • Policy certainty and policy stability is required once investors make commitments based on existing frameworks to protect mini grid viability<br>• Set procedures to be followed for tariff applications/renewals/changing of frameworks. |
| • Higher levels of government in the political establishment are more interested on levels of tariffs than the tariff tool per se. | • It is important to get governments buy-in on tariff settlement frameworks. |
| • Willing buyer willing seller agreements are not readily sanctioned by regulator, even where developers have agreed a tariff with the community the regulator may override such agreements in the public interest | • Negotiated tariff settlements (willing buyer and willing seller should be supported. Allow some flexibility for customization of tariff settlements. |

***Experience from using existing Regulators' respective standardised off grid tariff tool/Whether the regulator accept the tariffs generated by their respective tariff tool?***

| Experience and Lessons | Proposals on Improvements |
|---|---|
| • Existing tools have varying challenges that include: -<br>○ Some of the tools are very complicated needing a lot of information to get the tariff output. | • Strike a balance between the level of details requested by regulators and the developers' preferred broad categories to give metrics of how much it costs – this will reduce the excessive details requested in the current tools and reduce the burden of providing details that are unnecessary. |
| ○ the tools do not disclose all the inputs that are fixed | • Tools should disclose the inputs that are fixed |
| ○ the tool can be time consuming, and regulators take more time to process tariffs than what is specified in the regulations | • The regulators need adequate capacity to use the tool |
| ○ there is a lot of learning required on the costs<br>○ the cost benchmarks to use by the regulators for assessing costs are lacking-you can argue on every variable because there are varying assumptions on the cost inputs | • The regulators should develop benchmarks of costs but at the same time recognize that each project is different. The tool could have some outputs that will be collected for benchmarks, e.g., Capex per kW, Opex per kW, Opex per customer, etc |
| • Foreign Exchange rate depreciation adjustment is not mitigated in multi-year tariff orders (MYTO) that require tariffs to remain the same over the tariff control period | • Allow for adjustment of uncontrollable variables like foreign exchange depreciation and disclose all tariff variables that are fixed. |
| • Even if you have a tool that is working fine to give a cost reflective tariff, the difference between the national utility tariff and mini grid cost reflective tariff is on the longer term not sustainable because there is going to be political pressure to bring this tariff to be aligned to the grid. Developers may try to explain the difference in terms of service reliability, efficiency, but the debate on equity remains | • Consider alternatives to cost reflective tariff, such as:<br>1. having a national mini grids tariff for all developers that could be higher than the national grid tariff, but not excessively high, that is politically acceptable and can be explained to the public. The mini grid can even keep the national tariff but with the mini grids allowed to charge a service fee to cover the increased service level that mini grid provides (national utility service is very poor compared to mini grid service that is reliable, it is renewable, uses a local provider in the village to support the customers). The premium service will disappear as soon as the mini grid is connected to the national grid<br>2. having a national utility tariff and the gap between the mini grid tariff and national utility tariff be met with a tariff subsidy funded from donor community. The viability gap will be different for |

| Experience and Lessons | Proposals on Improvements |
|---|---|
| | each developer as they have different cost structures and IRR targets |

***How should the tool deal with excess capacity in the early years when demand forecast is below the installed capacity (Should the tool use demand forecast or installed capacity in the calculation of the tariffs)?***

| Experience and Lessons Learned | Proposals on improvements |
|---|---|
| • There is a real challenge that the forecast demand does not materialize after the system has been sized and installed, leaving excess capacity. The demand is lower due to fewer connections than forecast or the consumption per customer is lower than forecast. In some cases, consumption is also seasonal. | • Some developers are using modular designs to mitigate the risk of oversizing. It is better to start with capacity just enough for the immediate demand and increase size of mini grid as demand increases. This will lower the initial investment deployed. The same should be done with the distribution system-it is takes longer for people to connect, and hence the need to start by building the distribution network where there is immediate demand for connection. But the developers are not sure if funders will agree to resulting loss of economies of scale. |
| • Regulators are right in not allowing the connected customers to pay for excess capacity by using the installed capacity in the tariff calculation. Developers are learning and improving on the way of sizing. | |
| • Cost reflective tariffs are awful when there is excess capacity | • Encourage productive uses of energy (PUE) initiatives to grow demand and improve the mini grid business viability |

***What is your preferred tariff control period (e.g., 1-year, multi-year of 3 years, multi-year of 5 years, entire license period, etc)? And what variables should have automatic annual adjustments?***

| Summary | Proposals on Improvements |
|---|---|
| • The risk of a tariff review is not good for financing. The longer the control period the better (i.e., at least five years or more) | • Structure the tool for a control period of at least 5 years with an option for life cycle tariffs |
| • The tariff should provide for automatic adjustments within the control period, for exogenous factors like foreign exchange depreciation and fuel costs | • Provide for annual automatic adjustments of foreign exchange depreciation, inflation escalation, fuel cost adjustment |

***Should the tool allow developers to choose their own tariff structure for each project (Note: Some Regulations have prescribed structures)/ What tariff structures should be provided for in the tariff tool? / Should developers be allowed to do inter-customer category subsidies? / How is the customer's ability and willingness to pay be factored into tariff structuring decisions?***

| Summary | Proposals on Improvements |
|---|---|
| • Where permissible, different developers follow different structures, and even the same developer may use different tariff structures in different contexts. Consumers are different and therefore sometimes uniform tariff structures may not be ideal.<br>• Examples of structures as alternatives to pure kWh tariff are:<br>-A tariff that comprises of a service fee plus a kWh component, where the kWh rate is similar to the national utility tariff and the service fee is for superior service/ reliability of the mini grid.<br>-Daily, weekly, monthly bundles based on services are superior offering for low-income customers. But these customers don't want those bundles to expire.<br>-Tariff structure that suits customers with a fixed budget (monthly) or customers with seasonal incomes | • The regulators should ensure consumers are charged affordable tariffs which are sustainable and allow developers flexibility to do their own tariff structuring<br>• If AFUR comes up with a tariff tool it will be very important to have flexibility on tariff structures, i.e., flexibility to use different tariff structures to suit individual project customer profiles. |

***How should the tool provide for valuation when the national grid arrives?/ What should be the valuation method of mini grids when the national grid arrives?***

| Summary | Proposals on Improvements |
|---|---|
| • There is a need for clarity on how to calculate the compensation<br>• Valuation should be part of the tariff tool and cannot be separated from the tariff and financing | • Valuation of the mini grid asset should be provided for in the tool for use in compensation when the grid arrives.<br>• For regulatory valuation, the asset net depreciated value should be considered |

***Other comments/observations on the mini grid tariff tool/ Other lessons learned from using existing regulator off grid tariff settlement tools***

| Summary | Proposals on Improvements |
|---|---|
| • Regulators should not deal with that complexity of individualised tariff and should move to a standardised national mini grid tariff with the difference being met with a subsidy. Such a standardised national mini grid tariff is defined by what is affordable and politically acceptable. The purpose of the tariff tool will be to show | • Look for a way to simplify approval process so that developers do not waste time and resources.<br>• Mini grid stakeholders in the various countries should converge on an agreeable mini grid tariff that is acceptable to the private and public sector. The difference between the mini grid tariff and the cost reflective tariff should be covered by a |

| Summary | Proposals on Improvements |
|---|---|
| the gap between the cost reflective tariff and the subsidy.<br>• Even if the tool provides desired tariffs, the regulators sometimes don't accept tariffs from their own tools, and lower the tariffs, because of political pressure.<br>• There is a need to find an agreement between developers, investors, donors, regulators on the tariff to be achieved. That should be done at country level<br>• One of the key challenges with regulators is the bureaucratic process | smart subsidy. This will protect the interests and sustainability of the end consumer and prudently incurred investments by the private sector.<br>• AFUR to train the regulators at least three times a year on how to use these tools, especially MYTO, to increase competency in using the tools. |

## 9.3 Funders (Donors and Investors)

### 9.3.1 Introduction

The project activity also consulted with the funders that invest in the mini grid projects promoted by developers. This provided their perspectives on the mini grid financing landscape and the significance of tariff settlement in unlocking funding for scaling. The consultations with funders covered the following areas: -

1. Investments in mini grids-considerations and types of funding
2. Why mini grid tariff settlement tools are of interest to the funders
3. Concerns about the current tariff settlement frameworks in the countries of interest
4. Proposals for streamlining tariff settlements

A total of six (6) funders supporting mini grid projects across fourteen (14) African countries were consulted. These countries are Kenya, Tanzania, Uganda, Rwanda, Ethiopia, Somalia, Zambia, Lesotho, Ghana, Sierra Leone, Nigeria, Benin, Democratic Republic of Congo (DRC), and Madagascar. Some of these funders are supporting mini grid projects in multiple countries. These countries include the five that have tariff settlement tools that were analysed. In order to reach a decision to invest in a particular country, some of the investors look at regulatory framework (e.g., energy strategy/master plans) even if it is not perfect, but so long as it shows goodwill by government to make the mini grid sector work.

### 9.3.2 Summary: Funding, concerns about current tariff settlements, and improvement proposals

The topic on tariff settlement is important to funders because the biggest challenge in scaling up mini grid deployment is the sufficiency of tariffs to recoup costs to achieve operational sustainability. Developers need tariffs to get funding as investors consider cash flows from these tariffs in making investment decisions. The tariff tools are important in giving developers and investors visibility on the tariffs that could expected. Tariff tools are also essential to speed up tariff approval processes.

**Type of funding:** These funders provide early-stage funding either directly or through other investment vehicles. The types of funding provided to the mini grids include: equity, debt, project finance and result-based financing (RBF). It is not all investors require the investees to necessarily have grants in place to be able to access debt/equity funding. Mini grids are nascent in nature and due to the inherent risks and bankability issues, there has been limited commercial and concessionary funding flowing into the mini grid space

**Concerns about current tariff settlements and improvements proposals:** The funders did not dwell on the mechanics of tariff settlement tools, but rather focused on the importance of tariff settlement and it impacts on their funding activities. The following are some of their observations and proposals:

Table 10: Funders' concerns about current tariff settlement, tools and improvements proposals

| |
|---|
| Mini grids face challenges in securing commercial debt funding from banks as stated above. The limited debt available is provided by a few development finance institutions (DFIs). The developers are therefore more reliant on equity funding. Yet regulators apply target capital structure to mini grids that is not achievable in practice. The effect of this is that the return on capital calculations is artificially lower that the reality. |
| The proposal is that the type and cost of finance varies from project to project and from funder to funder. This variation should be recognized by regulators. |
| A challenge for donors is that projects are too slow and not absorbing the available grant funding because the speed of regulatory approvals is very slow and lengthy. |
| The proposal is that tariff tools need to be in conjunction with strong regulatory frameworks that are functioning well. In addition, the AFUR initiative should come up with some regional guidelines on speeding up the regulatory approval processes. |
| Tariffs become very political. Governments don't always follow these tools because they want to reduce the tariff. It is a problem if the tariff is not financeable (too low) or not politically defensible (too high). |
| The proposal is that the tariff conversation should be linked to subsidy conversation. Rural electrification is a subsidized industry world over and no country has done rural electrification without a subsidy. It is therefore a challenge to have a fully privately funded mini grid without subsidies as the tariff will be too high. An example is to consider having standardised rural tariffs for mini grids instead of different individualised tariff. From this rural tariff is to work out a subsidy that is required for each village/project. The standard rural tariff may have a relationship with the grid tariff |
| Government overrides existing mini grid regulatory framework which unravels the economics of mini grid investments. |
| There is need for political buy in for governments to make commitments to stick to existing frameworks once the investor goes in. Revisions to frameworks should apply to new developments, not existing ones that are already invested based on existing frameworks. |
| Tools are different/separate from Regulations, even where it may be written in Regulations that tariff tools will be developed. |
| The proposal is that when developing the Regulations, the tool should be part of those Regulations and not separate documents. Also, the regulations should state key inputs to the tariff tool, e.g., the return on equity etc. |
| Countries are providing for compensation when the national grid arrives, but there is no certainty on who will pay the compensation. |

Nevertheless, valuation needs to be added in the tool so that regulators and developers can see and have a common understanding. Valuation should be site by site, taking into account age of assets and consumption.

Regulators are doing their best given this new market, but the regulators capacity is constrained. Hence the speed of regulatory approvals is very slow and lengthy.

The proposal is to build capacity and independence of regulators. To assist regulators in assessing reasonableness of costs, the tool should calculate specific CAPEX and OPEX benchmarks from the latest tariff approvals which are automatically compared to data provided by mini grid developers in their tariff application.

Other improvement proposals

The tool needs to be simplified and provide tariff certainty over longer periods instead of a year. To give tariff certainty, a tariff control period of at least 5 years is good. The tools should allow for foreign exchange adjustments, inflation and fuel cost adjustments.

Future tariff regulation should use digital tools (web application) to accelerate evaluation and approval procedures. Given the unreliable internet connectivity, the tool can be filled off-line and uploaded to the regulator server by the developer

Finally, funders noted that it is important that the policy put in place is right for that market and that the government owns it to avoid policy about-turn. And there is need to scale up licensing, adopt light handed regulation as well as "willing buyer willing seller" arrangements to speed up mini grid approvals for deployment.

### 9.3.3 Specific Questions and Responses

The following is synthesis of responses obtained to specific questions posed to the funders. The verbatim responses from these consultations are also provided in Annex 2 of this report.

***Funding to mini grids projects, investment horizon and expected rate of return***

| Summary | Proposals on Improvements |
|---|---|
| • A lot of mini grids are not economically viable, some funders are providing them with risk capital to reach the number of connections needed for economic viability<br>• Commercial banks are not extending debt to mini grids as yet but some DFIs are providing debt. Proportion of equity funding varies with some providing up to 50% equity. Innovative funding structures like project finance are being trialled.<br>• The expected rate of return varies with some only wanting to get their money and re-cycle into other investments. Others look for return on equity of 15% to 20%, but in reality, the IRR for mini grids is currently low at about 7%. It is hoped that once the mini grid brings in debt the IRR is | • The cost of finance varies from project to project and from funder to funder. This variation should be recognized by regulators<br>• Commercial debt is not accessible to mini grids, so the target capital structure used by regulators is not achievable in practice |

| Summary | Proposals on Improvements |
|---|---|
| likely to go up. The DFI cost of debt ranges between 5% to 9%.<br>• Time frame to exit is 10 to 12 years, but there are investors looking at 6 years. The tenor of project finance varies from 10 years to 15 years. | |

***As funder/investor why are off grid tariff settlement tools of interest to you?***

| Summary | Proposals on Improvements |
|---|---|
| • The biggest challenge in scaling up mini grids is the tariff as there are political issues around tariffs.<br>• Tariffs are a requirement for a developer to get funding. Investors will consider those tariffs in making investments decision<br>• There is lack of financing for mini grids, so there is interest on how to bring more investors and players into the sector.<br>• Since the returns are not high there is a need for certainty of cashflow from tariff for at least the investment period. If tariff is not certain, it means the government can change the tariff in one year which affects the mini grid economics. An investor wants to do sensitivity analysis of project cashflows, DSCR, loans repayments, to see impact of tariff changes<br>• **Tariff process is slow and burdensome. Tariff tool will shrink time to process tariffs** | • Tariff tools are essential to speed up tariff approval processes. Developers need tariffs to get funding and investors will consider these tariffs in making investment decisions. |

***What are your specific concerns about the current off-grid tariff settlement frameworks in the countries that your investees operate or are considering operating?***

| Summary | Proposals on Improvements |
|---|---|
| • The challenge for donors is that projects are too slow and not absorbing the available grant funding, because the sector is not working, political changes that make policy environment unpredictable.<br>• Tariffs become very political - Instances where government overrides the current mini grid regulatory framework which unravels the economics of mini grid investments. For example, in Tanzania, even though there was regulation in place, in reality the law gave the government power to change the tariffs. | • As donors, it does not matter what the tariff solution is, it just have to work. Tariffs need to be politically acceptable (cost reflective tariffs are too high) and financially workable (subsidy need to be reasonable)<br>• There is need for governments to make commitments to stick to existing frameworks once the investor goes in. Revisions to frameworks should apply to new developments, not existing ones that are already invested based on existing frameworks |

| Summary | Proposals on Improvements |
|---|---|
| • Tools are different/separate from Regulations, even where it may be written in Regulations that tariff tools will be developed.<br>• Regulators are doing their best given this is a new market, but the regulators capacity is constrained. Hence the speed of regulatory approvals is very slow and lengthy<br>• It is a problem if the tariff is not financeable (too low) or not politically defensible (too high) | • The Regulations should state key inputs to the tariff tool, e.g., the return on equity etc, and when developing the Regulations, the tool should be part of those Regulations and not separate documents<br>• There is a need of balancing between investors needs and making sure electricity is affordable to overcome the tariff being political issue. When the differential between cost-reflective tariff and main grid tariff is too high, it becomes a risk of being politically unacceptable<br>• The appetite for the right tariff tool varies widely from country to country based on unique political systems, e.g., Nigeria vs Ethiopia |

***How should this AFUR initiative, developing a standardised off grid tariff settlement tool, help address these specific concerns?***

| Summary/Proposals on Improvements |
|---|
| • Because of cost differences between mini grid projects, a cost reflective tariff for each project is going to have a patchwork of tariffs. But governments do not want a patchwork of tariffs. The AFUR initiative could consider a standard Rural Tariff specific to each country.<br>• There is a value in the tool. It gives investors and developers confidence. It gives visibility on the tariff. But it needs to be in conjunction with strong regulatory frameworks.<br>• Regulators in Africa are in different geographies and are in different stages of regulatory frameworks development. AFUR can be a platform for learning between these regulators, facilitating peer-to-peer learning between countries, with those that have moved along share experiences with those that are at ground zero, or those that have only started to think about it to facilitate robust development<br>• AFUR initiative should come up with some regional guidelines on speeding up the tariff approval process<br>• Governments don't always follow these tools because they want to reduce the tariff. AFUR should sensitive governments that, to change a regulatory framework, there must be a formal way of doing so, rather than arbitrarily going against an existing regulatory framework |

***Besides developing a standardised tariff tool for individualised tariff settlement, what other proposals should be considered to improve regulatory efficiencies in tariff settlement processes? – e.g., use of benchmark tariffs, or portfolio tariff settlements, etc***

| Summary/ Proposals on Improvements |
|---|
| • Consider having standardised rural tariffs for mini grids instead of different individualised tariff. Using this rural tariff, work out a subsidy that is required for each village/project. The standard rural tariff may have a relationship with the grid tariff<br>• Some investments are enabled by subsidy and if there is no subsidy the investment is unlikely<br>• Improve tariff approval timelines; Approve tariffs at a portfolio level rather than individual sites |

| Summary/ Proposals on Improvements |
|---|
| • Future tariff regulation should use digital tools (web application) to accelerate evaluation and approval procedures - given the unreliable internet connectivity, the tool can be filled off-line and uploaded to the regulator server by the developer<br>• Most important is that tariffs must be cost reflective. If a cost reflective tariff is not possible, the tariff must be accompanied by a subsidy<br>• Calculate specific CAPEX and OPEX benchmarks from the latest tariff approvals which are automatically compared to data provided by mini grid developers in their tariff application |

***What tariff control period (annual, 3 years, 5 years, lifetime) are of interest to funders to help unlock long term funding to the off-grid investees?***

| Summary | Proposals on Improvements |
|---|---|
| • The tool needs to be simplified and provide tariff certainty over longer periods instead of a year | • To give tariff certainty, a tariff control period of at least 5 years is good. It should allow for FX, inflation and fuel cost adjustments |

***Who should bear the costs in the early years when demand is below generation capacity? How should tariff tool deal with the high unit cost/excess capacity arising from lower than forecast demand in the early years?***

***What other recommendations should be considered to address the off-grid viability gap/PUE?***

| Summary | Proposals on Improvements |
|---|---|
| • Mini grids developers are offering solutions in PUE to make economics work and funders are looking at these PUE positively as the PUE improve the economics of the mini grid. There is differing levels of success among developers in PUE initiatives. It is also challenging for developer to run both the utility business and the PUE business, but overall PUE leads to positive outcomes<br>• The cost reflective tariff is awful where there is excess capacity because if you try to charge a cost reflective tariff, nobody will afford it | • Tarff conversation should be linked to subsidy conversation. The idea above of a Rural Tariff coupled with a subsidy should be considered<br>• Developers should try to reach the maximum number of connections with money available<br>• Developers should allow time to ramp up consumption<br>• Staged implementation of mini grids is an option to mitigate this excess capacity risk. |

***How should the tool provide for valuation when the grid arrives? What should be the valuation method (e.g., historical cost, DCF, Depreciated, Replacement Cost, etc) of off grid assets when the grid arrives?***

| Summary | Proposals on Improvements |
|---|---|
| • Countries are providing for compensation when the grid arrives, but who pays is still a question to be addressed. The approach in fully liberalised markets like Nigeria may differ from those with centralised utilities as the later may require the compensation | • Valuation should be covered in the tool.<br>• The valuation should be reflective of investment - e.g., depreciated cost of assets |

| Summary | Proposals on Improvements |
|---|---|
| to be budgeted for and to be given parliamentary approvals.<br>• Valuation needs to be added in the tool so that regulators and developers can see and have a common understanding<br>• Valuation should be standardised. Valuation should be site by site, taking into account age of assets and consumption | |

***Any other comments/observations on the off-grid tariff settlement tool that should be considered in this AFUR initiative***

| Summary | Proposals on Improvements |
|---|---|
| • Rural electrification is a subsidized industry world over and no country has done rural electrification without a subsidy. it is therefore a challenge to have a fully privately funded mini grid without subsidies as the tariff will be too high.<br>• Mini grids face pressures arising from affordability and equity issues. This is caused by the fact that those connected to the grid pay lower tariff compared mini grids' higher tariff<br>• Tanzania challenges reflects the policy uncertainties developers face. They had a free-market policy for a country that was not ready for it<br>• The mini grid space is still nascent, and investors are also learning | • It is important that the policy put in place is right for that market and that the government owns it to avoid policy about-turn<br>• It is a challenge to have a fully privately funded mini grid without subsidies as the tariff will be too high. So mini grids need subsidies<br>• There is need to scale up licensing, and adopt light handed regulation to speed up mini grid approvals for deployment |

## 9.4 Policy makers (Government Ministries Responsible for Energy)

### 9.4.1 Introduction

The project activity also consulted with some government ministries responsible for energy obtain the policy makers' to provide perspectives on:

1. Electrification policy framework on the role of off grid mini grids in the country's electrification strategy
2. Service territory allocation and licensing
3. Mini grids tariff setting, tariff tools and cost reflective tariffs

The government ministries consulted include Zimbabwe, Burkina Faso, Rwanda, Uganda, and Ethiopia.

### 9.4.2 Summary: Mini grids in electrification plans, services territory allocation and tariff setting

The policy makers consulted have embraced, within their national electrification strategies and masterplans, mini grids as one of the ways to increase electrification in rural areas where the national grid extension is not viable. Countries are using both competitive (solicited) and/or unsolicited

approaches to allocate mini grid service territories. The policy makers recognize the challenges of tariff setting for mini grids to balance between affordability of tariffs to the people versus cost reflective tariffs desired by investors to attract investments for mini grids development. Policy makers recognize that to achieve this balance will require subsidies and fiscal incentives to lower mini grid tariffs and plug the viability gap.

The private sector participation varies from country to country with tariffs being a key factor in attracting private sector investment. The mini grid sector is currently constrained by lack of funding, lack of guidelines on tariff setting for mini grids and high cost-reflective tariffs that are not politically acceptable from an equity perspective.

In some countries mini grid development is in early stages led by public sector using government/ World Bank/AfDB/donor funding and the private sector participation is through competitive bidding for service territory allocation and as a means of getting lower tariffs. In a country like Burkina Faso, government fiscal incentives are only available to the cooperatives, thus limiting the private sector participation, while in Ethiopia the private sector is invited to bid under a build, operate and transfer (BOT) program.

Generally, it is observed that various policy makers have evolving mini grid strategies and regulatory frameworks with a desire to crowd in private sector participation. These policy makers are supportive of the AFUR tariff settlement tool to guide the development of a sustainable mini grids sector.

### 9.4.3 Specific Questions and Responses

The following section summarises the responses to specific questions during the consultations. The verbatim responses from these consultations with ministries of energy are also provided in Annex 2.

**Role of mini grids in country electrification masterplans and strategies**

Zimbabwe – The Rural Electrification Masterplan demarcates rural areas for electrification using mini grids. The Rural electrification fund (REF) conducted an economic feasibility that identified major sites that could viably be electrified using mini grids. The REF avails this economic feasibility report to mini grid developers for use in choosing sites to develop.

Rwanda - The National Electrification Strategy (NES) aims to achieve 100% universal access by the year 2024 through grid, micro grids, mini grids, and solar home systems. The NES identifies demarcated areas for electrification using mini grids.

Uganda – The Rural Electrification Masterplan identifies areas to be electrified through off grid systems.

Burkina Faso - Burkina Faso is currently updating its Energy Masterplan, in which it is looking at providing prominence to the extension of mini grids into rural areas.

Ethiopia - The government of Ethiopia (GOE) has the National Electrification Program (NEP) developed in line with Sustainable Development Goals (SDG) 7 Agenda. In the NEP the GOE used spatial least cost approach to assign between electrification through grid extension versus off grid. The department of energy provides oversight of both grid and off-grid electrification. The NEP is available to the private sector.

**Mini grids service territory allocation and licensing**

Zimbabwe – A developer picks a site from those sites identified by REF. The REF signs an MOU with the developer on behalf of government of Zimbabwe (for the life of the plant) for the selected site. The allocation is therefore on a first come, first served basis.

Rwanda - The mini grid guidelines provide for both solicited and unsolicited projects. Solicited projects are procured through tendering for mini grid sites whose feasibilities studies have been done by Ministry responsible for energy. For unsolicited the sites must be in demarcated areas nationwide.

Uganda -The government packages the projects and tenders them out (solicited projects). The developer puts in their bids which are then selected on technology and lowest price.

Burkina Faso - The Regulator gives a conformity approval which the developer then takes to the Ministry of Energy to be issued with the license. But private sector participation in mini grids development is limited due to the current policy that rural and urban areas tariffs must be harmonized. The government is trying to promote mini grids in 100 sites that have been identified through the Agency for Promotion of Electrification of Rural Areas who assessed each site's potential and profitability. The private developers will be selected through tendering, and the selected developers will be issued with the license

Ethiopia - The national utility is the major site selector. It is selecting a lot of sites that will be developed by both the public and private sectors which is going to be attractive to the private sector. After the site selection it is expected that site allocation will be through a competitive process. Licensing is the role of the regulator who is independent on these matters.

**Mini grids tariff setting, tariff tools and cost reflective tariffs**

Zimbabwe – The Zimbabwe Energy Regulatory Authority (ZERA) is responsible for off-grid tariff regulation. ZERA applies a light-handed regulation approach to mini grids. In this light-handed regulation, the tariff is agreed upon between the developer and the community and the regulator does not interfere in the agreed tariffs. Government can subsidize to lower tariffs, but if government hasn't put in any subsidy funding to meet the gap, it will not ask for lower tariffs. The regulator does not have a tool for mini grid tariff settlements. The government is supportive of a tariff tool and want to see a tariff that people can afford to pay.

Rwanda – The regulator, Rwanda Utilities Regulatory Authority (RURA) regulates the mini grids tariffs, and the government does not intervene. The operational mini grids are charging cost reflective tariffs, but the end users are complaining about the cost of the tariff which are four to five times higher than the national grid tariffs. This is raising the likelihood of competition with the grid in the future. The regulator has developed a draft tool for mini grid tariff settlement that is still being finalised. The tool will ensure cost comparison by generation technology. The Government through the Rwanda Energy Group (REG) is currently looking at the best ways of mobilizing and implementing subsidies and fiscal incentives that would reduce the level of tariff.

Uganda - The regulator, Electricity Regulatory Authority (ERA), is responsible for mini grid tariff regulation. In the invitation to bid for mini grid projects, the regulator sets the tariff caps, and these caps are known to bidders before they bid. The bidders propose their own tariffs in the bid within the cap. Even with these tariff caps, the consumers are always wanting lower tariffs. But government position is that consumers are better off with higher tariffs than no power at all.

Burkina Faso - The current policy on tariffs is that rural and urban areas tariffs are harmonized. After this policy was put in place, it has been realized that it does not allow development of mini grids in rural areas. Currently there is no private sector participation due to this harmonized tariff regime. The

government is approaching the regulator for ideas on tariffs so as to attract investors. The AFUR study is very welcome as it will inform decisions to attract mini grids development.

Ethiopia - Regulator is responsible for tariffs. The regulator has developed a new tariff guideline aimed at determining cost reflective tariffs for micro grids.

# 10 Early Proposals for Structure of an Enhanced Tariff Settlement Tool

This baseline gap analysis presents the gaps in the respective country mini grid tariff tools, the experiences and lessons by the regulators and developers in using existing tools along with the proposals for improvements. It also presents the funders' areas of concern along with their proposals to address those concerns. This report also provides some policy makers' perspectives on role of mini grids rural electrification and the regulatory frameworks including tariff settlement. These early proposals consolidate the findings from gap analysis and stakeholder proposals, supplements it with considered regulatory practice, and the recommendations from the literature review conducted in the early activities of this project.

A range of proposals covering the entire mini grid policy and regulatory framework (legal licensing and provision, cost recovery and tariff regulation, financing support to mini grids, grid interconnection upon grid arrival) were provided. Our early proposal for structuring on tariff settlement focuses on cost recovery and tariff regulation in line with the project objectives. This early proposal covers the following:

1) Tariff methodology underlying the tariff tool
2) The tool
    a. Input variables
    b. Calculations
    c. Outputs
    d. Sensitivity analysis, including analysis of the relationship between tariff and demand
    e. User Guide

## 10.1 Tariff methodology underlying the tariff tool

The tariff tools currently in use are all based on the cost of service (or rate of return) methodology. The cost of service methodology is a form of a "cost-plus" tariff calculation in which the regulator determines the tariff based on a full accounting of the mini grid's full costs (both capital and operational) as well as required investor returns and profit margins. This is expressed as:

***Revenue Requirement= Depreciation+ O&M expenses + Taxes + (Rate Base x Rate of Return)***

That is not to say that the cost of service methodology does not have any flaws. The following are some strengths and limitations of the cost of service methodology of regulation:

**Advantages of Cost of Service Methodology**

- Simplicity – easily understood by both regulator and regulated entities
- Financial viability – regular reviews of Cost of Service assures the utility recovers costs and remains financially viable
- Flexibility – easy to adjust to changing regulatory circumstances or industry conditions
- Certainty of returns on investments – Regulator assures (but not guarantees) the utility a return on investment which then reduces the investment risk and lowers cost of capital that may translate to lower utility prices

- Creates an incentive for the utility to cut costs and increase sales compared to forecasts in order to earn higher returns than authorized

**Disadvantages of Cost of Service Methodology**

- The allowed return on the rate base can be a contentious matter. Regulators overcome this shortcoming by setting a generic formula to determine the allowed rate of return. The formula uses an optimal capital structure from a representative group with similar business risks; risk free return based on some long-term government bonds, plus a risk premium; and a procedure for annual adjustment of the allowed rate of return on equity.
- There is no direct incentive for utility to reduce costs if those costs can be passed through to the consumers in the tariffs. Incentive to improve productivity is further dampened when the utility's efficiency improvements are quickly captured for the benefit of the consumer in the next tariff review cycle.
- It provides skewed incentive to add unwanted capital investments or overstate capital base in order to earn a higher return on rate base
- There is no motivation to improve customer service and no penalties for failure to innovate

Despite the above limitations, the cost of service regulation is the most widely used methodology by regulators, though some regulators have made adjustments to the basic cost-of service model to, for instance, include efficiency incentive elements.

The tariff tool will be based on the basic cost of service model, to determine the revenue requirement that the developer is entitled to. The tariffs structure is then used as the means by which revenue requirement is recovered from the various customer categories. To structure cost-based tariffs for each customer category one needs the cost of serving each customer category.

## 10.2 Structuring of the tool

In addition to flexibility on the inputs and outputs, the tool should allow for both site-specific and portfolio (batches/ bundled /averaging) tariff approvals for use where the country's mini grid regulations allow portfolio approvals. Portfolio approval eliminates the need to have a patchwork of tariffs even where the sites are contiguous. It will also allow tariff regulation to be adapted to approve very many small projects over a short period of time to mitigate the challenge of slow processes alluded to by stakeholders.

The following elements are to be considered in the structure of the tool:

| **Revenue the developer is entitled to is the Revenue Requirement (RR)** |
|---|
| **RR = Regulated Asset Base x Rate of Return + Depreciation + O&M expenses + Taxes** |

Table 11: Enhanced Tariff Tool Structuring: Inputs, Calculations and Outputs

| Input Variables | Remarks |
|---|---|
| 1) Capital costs | This will be grouped according to useful lives. The regulators tend to propose useful lives to ensure standardisation.<br>Provisions will be made for the following capital costs<br>a) Generation - solar, wind, battery energy storage, small hydro, and genset (backup) generation technologies, Inverters and Charge Controllers<br>b) Distribution network<br>c) Metering and sales |

| Input Variables | Remarks |
|---|---|
| | d) Interest during construction<br>e) Mid-cycle asset replacement |
| 2) Working capital | This will be based on a formula in regulatory practice |
| 3) Operating and maintenance (O&M) costs | Grouping in sufficient details to differentiate cost categories<br>It will provide for a proportion that escalates annually<br>Explain in the User Guide expenses that are disallowable or capped |
| 4) Subsidies | This will provide for those that will<br>-reduce capex and therefore depreciation<br>-reduce O&M |
| 5) Non-tariff revenues | This will allow for<br>i. Connection fees<br>ii. Penalties and re-connection fees |
| 6) Finance | This will provide for cost of debt and equity, capital structure, tax rate and WACC calculation post-tax<br>Any elements that are fixed are to be specified in the User Guide |
| 7) Customer categories and customer numbers | The user to propose customer categories, if regulations allow.<br>Examples are<br>o Residential/households<br>o Business basic shops for lighting; Business with appliances like fridges<br>o Anchor customers - Mines/Timber Mills/Large Business<br>o Street Lighting<br>o Institutions – schools, health centres, administrative centres, etc |
| 8) Economic data, etc | Foreign exchange rates, inflation rates, fuel costs will be provided for and their annual adjustments to the tariffs |
| 9) Portfolio applications/ aggregation | This provide tabs for induvial site costs to be submitted whose aggregates are then used as singular inputs in a tariff calculation |
| 10) Plant capacity and net energy output | This provides for capacity factors, plant degradation, availability, reserve margin, and technical losses |
| 11) Cost allocation between customer categories | To allow cross-subsidization between customer classes developers will be permitted to re-allocate costs between customer classes for tariff structuring |
| 12) Benchmarks | i. Avoided costs to the customer and to the utility (cost of connection for the utility providing services)<br>ii. Capex per kW<br>iii. Opex per kW<br>iv. Opex as a % of capex<br>v. Average Revenue Per User (ARPU)<br>vi. Tariffs |

| Calculations | Remarks |
|---|---|
| 13) Calculations | a. Depreciation – straight line and one other?<br>b. Net energy output<br>c. Revenue requirement<br>d. Optimisation/elasticity scenarios – level tariffs should come down to stimulate demand up to available capacity (grid optimisation)<br>e. True up/Regulatory deferrals (debits and credits) |

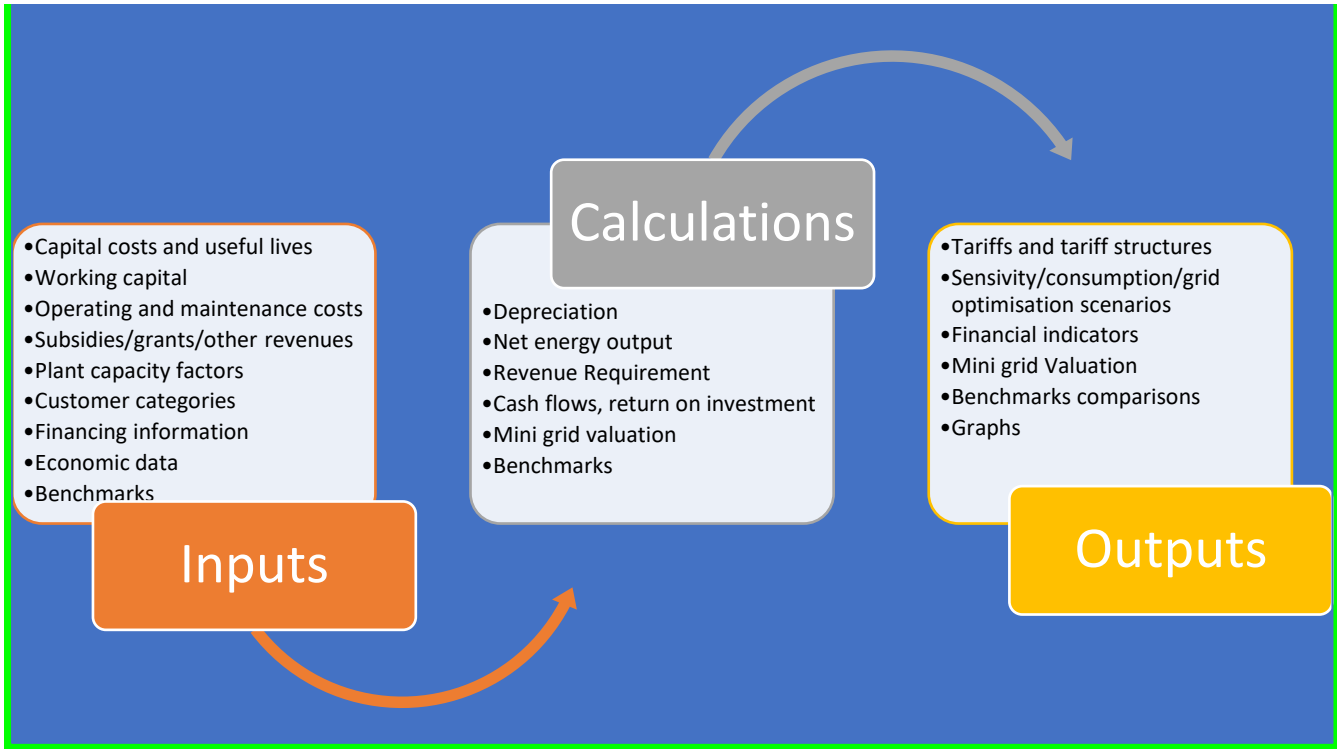
| Calculations | Remarks |
|---|---|
| 14) Depreciation and Amortisation methods | Depreciation is the proportionate allocation of the cost of asset to each of the benefiting periods involved the service life of that asset. The depreciation amount is crucial as it filters through to the cost of service in the tariffs. There are three methods of depreciation:<br>1. Straight-line method - Straight-Line is the most common method that we encountered used by the regulators. The annual depreciation is calculated by dividing the asset value (less salvage value) by the number of years of the asset's useful life. If the Historical cost convention is use to value assets, then the depreciation under the straight line method is one constant amount.<br>2. Units-of-output - Units-of-output method allocates the depreciable asset value over the units of output (e.g., machine hours) rather than years of use. This approach is used where the asset life is best measured by identifiable units of asset "consumption". The Units of Output method was provided in the Kenya regulator's tool as an option, but no developer has used it.<br>3. Annuity Method (also called the compound interest method of depreciation) - The annuity method of depreciation is used for assets that have a high initial cost and a long life span. It takes into account the interest lost on the money spent to buy the asset. A disadvantage of using this method is that it can be difficult to understand and that it may require frequent recalculations depending on the asset. This Annuity method is used in the Sierra Leone and Nigeria tools.<br>For this tool, the straight-line method will be the default method. While the depreciation + return on investment may lead to higher tariffs in early years, this may be advantageous to the developer in raising subsidy now, and the lower tariffs in later years may compare better with new entrants given the declining long run marginal costs as capex of new renewable energy investments are coming down. |

| Outputs | Remarks |
|---|---|
| 15) Outputs | a) 5-year tariff control period with the following:<br>b) Tariffs by customer category – the user to propose structures? Examples are:<br>• Energy-based tariffs/PAYGO<br>• Power-based tariffs<br>• Service fee-per customer-per month tariffs<br>• Combined Energy-based tariffs with a Service fee-per customer-per month tariffs<br>• Time of Use (ToU) tariffs<br>c) Cash flows and financial indicators – Equity IRR, NPV, Debt Service Cover Ratio, Times Interest Cover, etc<br>d) Comparisons against benchmarks<br>e) Graphs |
| 16) Valuation when the grid arrives | The valuation will be based on the asset costs net depreciation plus any other revenues owed by customers. |
| 17) Sensitivity analysis | a) Inputs variations – all inputs<br>b) Outputs variation – tariff to get required subsidy, IRR to get required tariff, subsidy to get tariff and IRR, |

| Outputs | Remarks |
|---|---|
| | c) Price elasticity of demand – inputs and outputs<br>d) Relating subsidies to connections to tariffs<br>e) Grid optimisation consumption analysis – additionality to the model where we have scenarios |
| 18) User Guide | A summary within the tool plus a separate detailed MS Word/PDF document<br>Specify in the user guide sources of data<br>Specify within the user guide the input variables that are fixed |

The following schematic summarises the above structural elements into the three main areas of inputs, calculations and outputs:

Figure 4: Enhanced Tariff Tool Inputs, Calculations and Outputs




## 10.3 Other proposals considered:

### 10.3.1 Capitalising opex to lower tariffs in the early years versus deferring revenue

The choice here is whether to defer expenses or to defer revenues. The regulatory practice is to defer revenues (i.e., revenue shortfalls are deferred for recovery in future years). These deferrals are provided for in Regulatory Deferral Accounts (regulatory debits and regulatory credits) in terms of international financial reporting standard 14. It is proposed for this tool to use the regulatory deferrals as provided for in regulatory practice.

### 10.3.2 Price elasticity of demand

The concept of incorporating the impact of reducing mini grid tariffs on customer consumption (price elasticity of demand) and grid Net Present Value (NPV) derives from the CBEA Lab pilot that tested the impact of lower tariffs on customers, developers, and subsidies. The pilot started in June 2018 CBEA Lab funded developers to reduce tariffs by between 50% and 75% at five rural mini grid sites in Tanzania. During the 5- year pilot, the Lab provides a 5-year subsidy that allows developers to reduce

tariffs charged to customers and not have a negative impact on project returns (NPV). The pilot results show that:

1. Governments cannot mandate lower tariffs without seriously damaging the business case for mini grid developers, and developers should not introduce them without financial support. The tariff reductions implemented under this prototype resulted in a decrease in average Net Present Value (NPV) of 13%, excluding subsidy payments.
2. Tariff subsidies benefit all categories of mini grid customers, but the greatest impact is felt by the lowest using, and likely lowest income customers (Low using customers are the most price sensitive of all customer groups, and ready to use more power).
3. Less subsidy is required than is typically provided to the main grid because the increase in consumption reduced the amount of lost revenue that subsidy needs to bridge.

*(Source: Innovation Insight: Measuring the impact of reducing mini-grid tariffs on customer consumption and grid NPV, Cross Boundary and Energy4Impact, September 2020)*

For this AFUR project of developing an enhanced tool the price elasticity functionality will be provided for in the tool as a standalone sensitivity scenario analysis. Given the CBEA Lab pilot was conducted in only one country (Tanzania) and on just three project sites, the data on price elasticities is still limited for a standardised approach across countries. The tool will provide for the developers to input the parameters required for conduct this price elasticity of demand. The functionality in the tool will allow developers to input baseline tariff, baseline average consumption per user (ACPU), baseline average revenue per user (ARPU), the elasticity/relationship between tariff and demand for different customer profiles, the time/months it takes from tariff reduction to when ARPU returns to baseline. The output will be the required subsidy to achieve NPV neutrality, reduced tariff (i.e., what the price needs to fall to for extra demand). The CBEA/E4I report notes that, at sites where demand is close to generating capacity, serving new connections may also require additional investment in generating capacity that reduces overall project returns, which also means where there is opportunity for grid optimisation where the there is some unutilized capacity.

# 11 Conclusion

This baseline analysis presents the gaps in the respective country mini grid tariff tools, the experiences and lessons by the regulators and developers in using existing tools along with the proposals for improvements. It also presents the funders' areas of concern along with their proposals to address those concerns. This report also provides some policy makers' perspectives on role of mini grids in rural electrification, their countries' respective regulatory frameworks and tariff settlement.

This report is informative to mini grids stakeholders by highlighting current practical bottlenecks and lays the foundation for the public-private dialogues on enhancements to mini grids regulatory frameworks and tariff settlements in the continent. It contributes to the knowledge base, knowledge sharing and peer to peer learning amongst the AFUR network of regulators. It complements the recommendations from the literature review conducted earlier in the project to enhance mini grid regulatory practice in the continent.

# 12 Annexure 1

## 12.1 Regulators Tools Evaluation and Consultations

The Regulators consulted along with evaluation of respective tariff tools are Zambia Energy Regulation Board (ERB), Tanzania EWURA, Kenya EPRA, Sierra Leone SLEWRC, and Nigeria NERC.

The review of the tools and consultation with the respective regulators on their existing off-grid tariff tools considered the following:

1. Overall tariff application requirements, processing, decision making and communication of the decisions
2. Tariff tool overview
3. Tariff tool inputs
4. Tariff tool calculations of revenue requirement and tariff structures
5. Tariff tool outputs and scenarios analysis
6. Lessons learned from using the tariff tool

The following table provides comparative responses for each of the question/criteria evaluated:

| 1. Overall tariff application requirements, processing, decision making and communication of the decisions | | | | | |
|---|---|---|---|---|---|
| | **Zambia (17 June)** | **Tanzania (18 June)** | **Kenya (21 June)** | **Sierra Leone (22 June)** | **Nigeria** |
| 1.1 What (e.g., legal basis) informed the regulator to have the tariff tool? | Mini grid Rules on Tariffs (2018) issued in terms of the Electricity Regulation Act | The Electricity (Development of Small Power Projects) Rules, 2019 | The Energy Act; Draft Energy (Mini-Grid) Regulations (2021); Internal Procedures and Guidelines for Regulating Mini-Grids (2018) | The tariff tool is provided for in SLEWRC Mini-grid Regulations 2019 | NERC Regulation for Mini-Grids 2016 issued in terms of the Act (EPSR Act 2005) – Annexure contains the MYTO tool |
| 1.2 To whom/which mini grid sizes is the tariff tool applicable? | Mini grid >100kW installed capacity. 0-100kW are exempt from tariff regulation | Electricity generator with an installed capacity of: (a) less than 15kW at a single site selling power to at least thirty retail customers; or (b) between 15kW and 100kW at a single site that either sells power at wholesale to a | -Customers far from the National Grid<br><br>-Up to 1 MW (Megawatt), also assumed in the draft mini-grid regulations for 2021 | The tariff tool is applicable to a full mini grid – i.e., 100kW installed capacity | Mini grid above 100kW of installed capacity. It is optional for <100kW to use the MYTO tool as per Regulation 20 (4)(a) |

| 1. Overall tariff application requirements, processing, decision making and communication of the decisions | | | | | |
|---|---|---|---|---|---|
| | **Zambia (17 June)** | **Tanzania (18 June)** | **Kenya (21 June)** | **Sierra Leone (22 June)** | **Nigeria** |
| | | Distribution Network Operators or at retail directly to a customer | | | |
| 1.3 What other information needs to accompany a tariff application? | Specified in the Rules | Financial and technical information on period under which tariff is applied | Specified in the Draft (Mini Grid) Regulations (2021) | It is prescribed in Regulation 59 and listed in Tariff Approval Application Form | Agreement with community; show community has agreed to pay that tariff; show a title of land where they want to put the project; ESIA from Ministry of Environment as well as the statement |
| 1.4 What are the steps in processing a tariff application after receipt by the regulator?<br>• Is there a public or private consultation of the tariff application? Who is consulted?<br>• Who bears the cost of the tariff processing, and what are these costs? | ERB issues a provisional evaluation of allowed costs at least 60 Business Days prior to the commencement of the forthcoming Regulatory Period and publishes the evaluation for stakeholder consultation<br>The cost is borne by the Regulator from the levies collected – currently charging 0.7% of annual turnover.<br>Public hearings are only for Category III. For category I & II once the mini-grid regulatory framework implemented will remove the need for public consultations | - There is public hearing meeting to collect comments from stakeholders<br>- The regulator bears all the costs of tariff process including its public hearing meeting costs | -The Authority undertakes a detailed analysis of the TAM and Feasibility Studies<br>-A public stakeholder consultation is undertaken by the Authority<br>-The of tariff processing is incurred by the Authority | Conduct a prudency test first followed by community engagement . Consumers affected by the rate are given an opportunity to be heard in order to make a final decision.<br>Community engagement cost is borne by the commission | Application is submitted online to NERC website filling all information required as well as the MYTO. When NERC receives it, reviews the tariff model, costs and if what they have proposed is reasonable. If the costs are too high, the developer may approach the Rural electrification agency to subsidise the tariffs. The cost of submitting/processing the permits etc is borne by the mini-grid operators and is part of the development costs |

| 1. Overall tariff application requirements, processing, decision making and communication of the decisions | | | | | |
|---|---|---|---|---|---|
| | **Zambia (17 June)** | **Tanzania (18 June)** | **Kenya (21 June)** | **Sierra Leone (22 June)** | **Nigeria** |
| 1.5 Is the regulator deliberation on the tariff application open to the public?<br>• Is the applicant given an opportunity to respond/make clarifications before any adjustments are made to its application? | Consultations are open to the public – The new Act is very specific<br>The applicant is part of the public consultation to respond to questions from the public. | Applicants are given an opportunity to respond/make clarifications before any adjustments are made to its application, the process is done during the public hearing meeting and in meetings held between applicant and regulator | The deliberation is open to the public.<br>Once a tariff application has been processed and approved, a gazette notice is done and published for the public | Yes, it is open to the community that is being affected. Regulator publishes the application and the decision in newspapers and government gazette. | NERC is not part of the consultation between the community and the mini grid developer |
| 1.6 After the regulator makes a tariff decision, is the applicant given a written decision and reasons for decision clearly showing the adjustments made to its tariff application to arrive at the regulator decision? | According to the Rules, If ERB does not approve the Tariff Adjustment it shall provide justifications why and propose an alternative Tariff Adjustment. The practice is that ERB communicates either way with the applicant | After the regulator makes a tariff decision, the applicant is always given a written decision known as tariff order and during the exit meeting the reasons for adjustments made to its tariff application to arrive at the regulator decision are clearly discussed. | The Authority communicates to the Mini-Grid Developer in writing the justification for adjustment of the Tariff applied by the Mini-Grid Developer at least fourteen (14) days before publication. | The Commission communicates the decision to the applicant in form of a Decision. In case of a rejection it communicates the acceptable rates and the reasons for these rates at the time the decision is communicated. | governed by the Business Rules of the Commission |
| 1.7 Is batch (portfolio) processing/one tariff approval for multiple sites allowed or each site must get its own tariff even if they are next to each other? | Usually, a tariff is tied to a site. They apply for a separate tariff for each site. | Allowable, but depends on the owner's proposal. Basically, every project need to be considered separately due to different economics for each project due to differences in location. | Batch (Portfolio) processing is done for Mini-Grid developers with varied sites granted that all site stakeholders are okay with the proposed tariffs suggested during stakeholder engagements | One tariff for all the locations, however the tariff varies by developer based on regions and costs they are incurring | They must have a tariff for each site. If they want an average tariff, they can but any compensation from DisCo is based on each site. |
| 1.8 What is the timeline for processing a tariff application? | Varies according to the Category of the mini grid | Within ninety (90) days | Within sixty (60) days | 30 days to 60 days from acceptance of the application | 30 days for submission of a complete application |

| 2. Tariff tool overview | | | | | |
|---|---|---|---|---|---|
| | Zambia | Tanzania | Kenya | Sierra Leone | Nigeria |
| 2.1 What is the Tariff Methodology underlying the tariff tool? | Cost of Service Methodology to derive Revenue Requirement | Revenue Requirement Methodology – Hybrid | The underlying Methodology is Rate of Return regulation | The cost of service methodology underlies the tariff tool | Cost of service methodology |
| 2.2 What does the model entail:<br>• Outline of the model – what is covered in the model | It is an excel tool that covers – Instructions, Proposed tariffs for 3 years, capital expenditure – include commissioning date, sources of finance, and useful live, customer numbers, projected sales revenue and volume, recurrent subsidies, capital subsidies, non-regulated revenues, O&M, depreciation, return on investment. | Considers all justifiable operation and maintenance costs, depreciation costs, return on equity and tax. | The Model has sheets detailing the following:<br>1. Capital Cost Details of the Mini-Grid<br>2. Tariff Inputs<br>3. Loan Drawdown<br>4. Load Profile<br>5. Tariff Calculator<br>6. Loan Repayments<br>7. Financials<br>8. Output summary<br>9. Sensitivity Analysis | The model is similar to Nigeria's that has:<br>Input_Various,<br>Input_Demand,<br>Input_Cost,<br>Input_Asset,<br>Tariff calc, Asset definition tabs | The model provides a Guide tab along with 6 inputs (Insert) tabs, a tariff calculator tab and Graphs tab. The 6 inputs tabs are: Insert_Finance, Insert_Customers, Insert_Operational Cost, Insert_Disco, Insert_Asset Definitions, Insert_Assets |
| 2.3 Outline of the user guide – what is covered in the user guide<br>- does it specify variables that are fixed? | User manual is not published yet<br>-Tariff tool assumes zero collection loses as it encourages prepaid meter. Network losses of 3% allowed | User guide includes tariff application guideline for regulated utilities in the electricity and natural gas subsectors, 2017 | The user guide explains each element contained in provided sheets of the Tariff Application model. | The user guide is a separate MS Word document. It cross references the numbering in the Input tabs, the item, description of the item entry, the cell range, and units/format of the item entry<br>- It does not specify the variables that are fixed | The first tab of the tool is the Guide. It describes each input in each tab, the range of cells for that input and the input data format (text, date, %, etc)<br>-It does not specify variables that are fixed. |

| 2. Tariff tool overview | | | | | |
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| | Zambia | Tanzania | Kenya | Sierra Leone | Nigeria |
| 2.4 How long is the interval between tariff reviews (tariff review cycle)? e.g., 1 yr, 2 yrs, 3 yrs, etc<br>- Does the tariff tool provide for automatic annual adjustments (within the review cycle) of changes due to inflation, interest rates, exchange rates, generation capacity, primary energy/fuel costs, etc? | Three (3) years for Category I and II mini grids whilst five (5) years is adopted for Category III mini grid.<br>The tool does not allow automatic adjustments, but if the set materiality threshold is breached then developer can apply for adjustments | Multi-year tariff covers three (3) years period | 1.The first review is done after one year, after which three- year reviews are made<br>2.The tool provides for automatic adjustments | Five MYTO Tariff with minor annual tariff reviews<br><br>Manual annual adjustments for five years | The MYTO allows for up to 5 years review cycle.<br>-The tool allows for the user to input inflation rate (Insert_Finance)<br>Regulation allows review by showing the cause (could come from community or developer), otherwise they are supposed to hold the tariffs at the same level for 5 years |
| Generation technologies covered in the tool | | | All renewable energies and genset | Solar and genset, hydro, biomass, other | |

| 3. Tariff tool inputs | | | | | |
|---|---|---|---|---|---|
| | Zambia | Tanzania | Kenya | Sierra Leone | Nigeria |
| 3.1 Capital costs<br>-itemised or groupings?<br>-What informs the grouping/itemisation, e.g., is it based on useful lives/depreciation years | Capital costs have an asset schedule and itemised by useful lives.<br>The tool has itemised for Solar and hydro. Distribution infrastructure on its own – transformer, substation, poles and fixtures, and meters | Itemised. Capital costs are considered under depreciation whereby the straight-line method is always adopted | Capital costs are itemised, based on useful life which informs the depreciation years | The assets are grouped according to useful lives/depreciation years and common usage characteristics | The groupings used are: Generation Assets, Project Development Costs, Initial Operating Costs, Distribution Assets, Customer Connections, and, Company Wide Costs<br>The Assets are categorised based on functional features as well as useful lives |

| 3. Tariff tool inputs | | | | | |
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| | Zambia | Tanzania | Kenya | Sierra Leone | Nigeria |
| 3.2 What is the valuation basis of the capital assets – e.g. historical cost, replacement cost, etc | The assets are valued at replacement cost | Historical cost | Historical cost basis less depreciation | The assets are valued at historical cost prescribed in the Regulations | The assets are valued at historical cost |
| 3.3 Working capital<br>-what are the provisions regarding working capital allowance and how is it provided for in the model? | Working capital is allowed into the Revenue Requirement and a formula based on 1/12 (one month) of specific items is prescribed in the Rules on Tariffs | Working capital allowance is considered under Regulatory asset base | There is a provision for working capital in the tool, the no of days is at the discretion of the regulator | There is no provision in the tool for working capital | The operators use smart meters and prepaid, hence no working capital |
| 3.4 Depreciation<br>-what method is used and why?<br>-How is the depreciation calculated for assets whose lives are shorter than the lifecycle of the plant?<br>-How does the model capture mid-cycle replacements? | Depreciation method is the straight-line and is prescribed in the Rules on Tariffs<br>The model does not provide for asset replacements | Depending on each asset's lifespan, Straight-line depreciation method is used to allow recovery of respective asset cost over lifespan of an asset | Tool provides for two methods, straight line and units of outputs. Most commonly used is the straight-line method. Assets are depreciated in line with their useful life. However, there is one weakness of the model as it sums up the depreciation values for all assets and takes that as the annual depreciation to feed into the Revenue requirements number. The challenge is with assets whose life is lower than useful life of the plant | The annuity method of depreciation | The annuity depreciation method is used, and asset will have a residual value<br><br>The year of acquisition is chosen from the dropdown menu |
| 3.5 Operation and maintenance costs<br>• what informs the grouping and | O&M wants line by line items to be provided to the regulator | -Operation and maintenance costs are considered to arrive at revenue requirement | Developer enters a proportion in % of the expenses that are to be | A complete listing of O&M line items is provided. There is a prudence testof costs | The operating expenses are grouped into "changing operational |

| 3. Tariff tool inputs | | | | | |
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| | Zambia | Tanzania | Kenya | Sierra Leone | Nigeria |
| itemisation? Is there a rule of thump on these costs – e.g., proportion that escalates<br>-is it clear in the methodology of expenses that are disallowable or capped | Lines that are not allowed are those expenses not related to electricity business e.g., sports team expenses, telkoms provision<br>Collection losses not allowed because of prepaid meters | -After review of all costs, only the prudent costs are considered | escalated on an annual basis.<br>Yes, only prudent incurred costs for the provision of the service are allowable<br>There are no expenses which are capped | and if they are out of range, adjustments are made. The tool does not specify disallowable or capped expenses, but is specifiedin other rules – political donation costs are disallowed | costs" versus "constant operational costs"<br><br>-There is no specific mention of expenses that are disallowed |
| 3.6 Returns on Investment<br>-how are these elements determined?<br>O Cost of debt<br>O Cost of equity<br>O Interest during construction<br>O Capital structure<br>O Tax on returns on investment<br>-Are the assumptions on the above explicitly stated in the tool such that they are known in advance by the users? | The reasonable return is calculated based on weighted average cost of capital, which sets cost of debt equal to the actual rate of financing<br>Capital structure - The gearing ratio is set to reflect the actual financing structure of the regulated Mini-Grid except where the gearing ratio is below 0.4 or above 0.7…<br>Tax – the return on equity is grossed up for tax in the WACC formula. | O Cost of debt - the interest of specific debt is considered<br>O Cost of equity – Capital Asset Pricing Model (CAPM) is adopted<br>O Interest during construction - capitalised<br>O Capital structure – ratio of 70:30 in Debt to Equity is adopted<br>O Tax on returns on investment - are considered after excluding all prudent costs from revenue at a rate of 30%<br><br>Cost of debt, cost of equity and capital structure are known in advance | Cost of debt is the actual cost of debt less tax (due to tax shield on interest payments)<br>After tax cost of equity is taken. Pre-tax cost is a hardcoded cell (developer inputs) ROE allowed is 18% pre tax<br>EPRA expects the utility to average a capital structure comprising of at least 70% debt and 30% equity.<br>These assumptions are in the internal guidelines used by the Regulator and are largely unknown to first time applicants<br>The interest during construction (IDC) is computed automatically using the number of months entered in the | The target rate of return is entered as one value, so there is no provision for cost of debt, cost of equity or capital structure. Each developer gets a different, rate of return.<br>There is no provision for interest during construction<br>There is no separate line for tax. It can be presumed that the rate of return is pre-tax | -Cost of debt the expected debt interest rate<br>-Cost of equity is prescribed in the Regulations as expected debt interest rate + 6% for registered mini-grids that do not submit a MYTO<br>-interest during construction is not expected<br>-It is not clear from revenue requirement how tax on returns are provided – probably assumes that the return cost of equity is pre-tax<br>-Except for the tax, it is clear from the Regulation and tool on the above assumptions |

| 3. Tariff tool inputs | | | | | |
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| | Zambia | Tanzania | Kenya | Sierra Leone | Nigeria |
| | | | Loan drawn down & repayment tab. IDC is capitalised and forms part of RAB | | |
| 3.7 How are debt repayments considered in the tariff tool? | It is part of WACC and Depreciation | Are not considered since are neither costs nor revenue | Debt repayments form part of the revenue requirements | Debt payments are part of the depreciation and rate of return | Debt payments are part of the depreciation and rate of return |
| 3.8 How are subsidies received treated in the tariff tool? | -Recurrent subsidies are treated as a negative cost<br>-Capex subsidy is a net on the RAB | Subsidies reduces the Revenue Requirement | Less capital subsidies from the RAB (don't earn a return), less recurrent subsidies from the O&M | On the Input_Asset tab, the % of assets not funded by grant is inserted on the Financing column | Input_Assets tab – use % of assets not funded by grant to exclude subsidies |
| 3.9 Other tariff inputs – list them and how these are built into the model | | Other tariff inputs are considered as factors affecting tariff such as inflation and exchange rates | Provision for annual degradation of panels, Availability of the plant<br>Provision of corporate tax | The tool has a reserve adjustment account – as a % input in Tariff Calc<br>The tool has a Performance Related Profit Margin – as a SLL input in Input_Various. | -Insert_DisCos – re-interconnection costs paid to the DisCos as a Usage Fee charge net of power sold to the DisCos. |
| 3.10 What are the sources of information used in the tariff tool for:<br>-<br>O interest rates/cost of debt,<br>O exchange rate,<br>O inflation rates, etc<br>-Are these sources of information clearly stated in the model and known to the model user? | Cost of debt is the actual incurred by the mini grid<br><br>No specified sources of information but use of Central Bank is encouraged. Interest rate they use the tax authority | Sources of information used in the tariff tool for:<br>-<br>O interest rates/cost of debt – debt certificates<br>O exchange rate – Bank of Tanzania<br>O inflation rates – National Bureau of Statistics | This is at the discretion of the developers but subject to the review by the regulator | Central Bank average exchange rate for the year is used<br>The developers are aware of this source of exchange rate information | Central Bank of Nigeria (CBN).<br>Interest is from their term sheet |
| 3.11 Mini-grid capacity<br>-What is the tariff model assumption on design | The tool only considers the energy sold. It does | -tariff model assumptions vary depending on the | Model assumes that the design is optimal and will be fully utilised. Tariffs | They ensure customers register before they go ahead to instal the | The tool does not consider design capacity-NERC looks at the tariff |

| 3. Tariff tool inputs | | | | | |
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| | Zambia | Tanzania | Kenya | Sierra Leone | Nigeria |
| capacity versus actual power dispatched/sold?<br>-How is capacity factors dealt with in the tariff model?<br>-How is the idle capacity treated in the tariff model (in the early years when consumption is still below the design capacity)?<br>-How long does it take the mini grids to reach full capacity (minus reserve margin)<br>-How does the model capture customer/ connections growths year on year? | not consider design capacity and idle capacity<br><br>The tool does not capture the customer growth connections. It uses projections and the developers provides actual numbers thereafter | environment and nature of project operations<br>-Actual power dispatched / sold is considered in the determination of tariffs<br>-Capacity factors for each technology are predetermined.<br>-Mini-grids are required to attain full capacity within 4 years of operations. Accordingly, the installed capacity should not exceed its projected demands within 4 years of operations. | are based on generated energy and not demand<br>Capacity factor is used to calculate the amount of energy generated by a plant as it shows the no of hours the resource is available<br>Idle capacity doesn't affect the tariffs as the models assumes all generated energy is dispatched<br>Length taken to reach full capacity would vary from site to site<br>Customer connections is used in re-calculating the fixed charges per customer per month and capacity expansion planning | capacity in a particular site.<br>-Capacity factor is used to calculate the amount of energy generated by a plant as it shows the no of hours the resource is available<br>-Idle capacity doesn't affect the tariffs as the models assumes all generated energy is dispatched<br>Length taken to reach full capacity would vary from site to site<br>Customer connections is used in re-calculating the fixed charges per customer per month and capacity expansion planning. The tool only considers demand and therefore no consideration of idle capacity<br>The tool is now a five-year MYTO tool and takes into consideration the year-on-year growth of customer/connection.<br>The model captures growth in connections year to year. Community | model to estimate the optimal power supply and modify to remove any excess capacity. If the tariff is too high, the less the subscribers. REA before giving a subsidy also checks to ensure not excess capacity. The tool only considers demand and growth in demand per customer + growth in number of customers<br>The tool does not consider capacity factors<br>There is no adjustment for idle capacity in the early years. The tool uses the Total Energy Consumption (kWh/year) in the tariff calculation and the full costs of the plant<br>The model uses the customer growth in Total Energy Consumption calculation |

| 3. Tariff tool inputs | | | | | |
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| | Zambia | Tanzania | Kenya | Sierra Leone | Nigeria |
| | | | | Health centers (CHCs) are allowed to consume 6.6Kw per day for free | |

| 4. Tariff tool calculations of revenue requirement and tariff structures | | | | | |
|---|---|---|---|---|---|
| | Zambia | Tanzania | Kenya | Sierra Leone | Nigeria |
| 4.1 Revenues<br>-How is the revenue requirement determined? (List the elements of revenue requirement) | Sum of depreciation, return, operating and maintenance costs, working capital, and allowed losses. | Considers operation and maintenance costs, depreciation costs, return on equity and tax expenses. | The elements of Revenue Requirements (RR) are:<br><br>RR = (RAB*RoR)+ O&M+ Depreciation+ Taxes | Revenue Requirement = O&M + D + T + (rate of return x RAB) + (Performance Related Profit Margin (SLL/kWh) * Electricity sold) | Revenue Requirement = Operational Cost + Depreciation + Return + Performance Related Margin + Payments to DisCos |
| 4.2 How are non-tariff revenues treated in the tariff model?<br>-Provide a list of those non-tariff revenues | Subsidies (as a negative cost)<br>Unregulated Income (as a negative cost) | Non-tariff revenues in the tariff model reduces the revenue requirement and may include connection charges and subsidies. | Non-tariff revenues are deducted from allowed revenue. | Grants for operational costs are subtracted from allowable revenues. Grant funded capital assets are removed from RAB in inputs_Assets % financing | The connection charge that is subtracted from the connection costs, Grant funded assets are removed from RAB using % non-grant financing in inputs_Assets |
| 4.3 Customer Categories<br>-How (on what criteria) are the mini grid customers categorised?<br>-Provide your list of mini grid customer categories | The developers come with their own customer categories – e.g. Low, medium and high consumption, residential, commercial, social | Mini grid customers categories depend on the applicant proposed groups, there are no specific or standard groups. However, general groups are basic residential, commercial, institutional and industrial. | 1. Customers are categorised based on their energy consumption/ load profile and cost of service costs allocation.<br>2. Customer Categories in the model: Households, Institutions, Business and Anchor | The developer are allowed to enter their own customer categories in Input_Demand tab | The developer are allowed to enter their own customer categories in Input_Demand tab |
| 4.4 Tariff Structure<br>-Which tariff structures are allowed? – e.g. 1) Energy-based tariffs (kWh | ERB sets principles only - Operators free to propose structure of tariff or service charge so | -Tariff structures differ from one developer to another depending on their metering facilities. | The tariff structure considered and approved is at the discretion of the Authority. | -The Regulations(57(2)(b) prescribes options of tariff structures to be (a) conventional kWh tariffs, | -The following two tariff structures are used: Average Pay as you go (PAYG) which same as |

| 4. Tariff tool calculations of revenue requirement and tariff structures | | | | | |
|---|---|---|---|---|---|
| | Zambia | Tanzania | Kenya | Sierra Leone | Nigeria |
| charge), 2) Power-based tariffs, 3) Time of Use Tariff, 4) Lifeline tariff, 5) Fixed charge + kWh tariff, 6) Fee-for service tariffs charge, etc<br>-Are developers allowed to use any tariff structure of their choice that best suits the project?<br>-Are the mini grid tariff structures required to be similar to that of the national utility?<br>-In structuring tariffs are developers allowed to do inter-customer category tariff cross-subsidies? | long as such a proposal meets general principles outlined in the rule. Provisions on tariff structures are not limited to kWh-based billing but are flexible and allow for other billing principles such as flat-rate-billing, TOU-billing or other service charge<br><br>No cross-subsidies are allowed | -There tariff structures depend on the nature of the customers, it may include energy based and/or time of use.<br>-mini grid tariff structures are not mandatory required to be similar to that of the national utility.<br>-In structuring tariffs, developers may be allowed to do inter-customer category tariff cross-subsidies. | The mini-grid tariff structure is not required to be similar to that of the national utility. Developers are flexible to introduce inter-customer tariff cross subsidies to ensure social policy objectives are met. | (b) flat rate tariffs, (c) power tariffs or (d) a combination of the above<br>-Tariff calc tab has input for "Cost factor" and that can be used to do inter-customer category cross subsidies<br>-Mini grid tariff structures are not required to have same structures as national utility | energy based tariff; Average flat rate tariff (Revenues/No. of customers), Average Day Time Tariff vs Average night time tariff (ToU)<br>-NERC allows other options of tariff structures so long as it enables the developers to collect their revenues<br>-MG tariff structures are not required to be similar to national utility tariff<br>-It seems developers are allowed to do inter-customer category tariff cross-subsidies – A base tariff is determined and all other tariffs are a % of that base tariff |
| 4.5 Payment Structures<br>-How is the customer's ability and willingness to pay factored into tariff decisions?<br>-What is your tariff comparator in the ability and willingness to pay - e.g., the avoided costs or national tariff?<br>-Does the model show the avoided costs of mini grid customers? | Category I &II developers conduct ability and willingness to pay surveys and rely on that. For Category III, ERB looks at avoided costs, but does not benchmark with national grid | Avoided costs are excluded in process of assessing the prudent costs to enhance ability to pay to customers | -Willingness and ability to pay helps the developer determine and assess how to structure different customer categories.<br>-WTP and ATP determine how to target subsidies/ grants therefore affecting tariff decisions<br>-The tariff comparator in WTP and ATP is the avoided cost tariff, | -Before implementation, the developer conducts an ability and willingness to pay.<br>-Customer using appliances complained of tariffs becoming a burden because of their choice of appliances. They are advised on a choice of appliance to manage their consumption | -There is a PAYGO tariff<br>-The comparator is not specified<br>-The model does not show the avoided cost of mini-grid customers |

| 4. Tariff tool calculations of revenue requirement and tariff structures | | | | | |
|---|---|---|---|---|---|
| | Zambia | Tanzania | Kenya | Sierra Leone | Nigeria |
| | | | mostly comparing with kerosene, which is the mostly used alternative. | | |
| 4.6 Valuation when the main grid arrives<br>-Is there a valuation when the national grid arrives and how is it done? | No valuation in the tool | When National grid arrives a number of options may be considered:<br>O Transferring the mini-grid to the national utility if it meets technical standards,<br>O Interconnecting with the main grid and operated by the developer by buying power from the utility. | Valuation is done based on the remaining depreciated value of the assets, plus any revenue the Mini-Grid Operator is owed by consumers but has not yet received up until the date of the transfer of assets. | -When the grid arrives the mini grid service territory, see Section 55 of the Mini Grid Regulation 2019 | At the arrival of the main-grid (DisCo networks) the permit holder will be entitled to a compensation equivalent to the depreciated value of the mini-grid network investment plus one year revenue<br>So far no DisCos has wanted to take over mini grid network. Developers choose a site and enter into exclusivity agreement with the community. The chosen site should not encroach a DisCo's territory in the DisCo's 5-year spatial plan, otherwise the developer must get the DisCos' agreement. The exclusivity agreement with the community is for 1 year and if they don't develop, someone else can go there and develop. |

| 5. Tariff tool outputs and scenarios analysis | | | | | |
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| | Zambia | Tanzania | Kenya | Sierra Leone | Nigeria |
| 5.1 What are the outputs of the tariff tool?<br>-How is sensitivity analysis provided for in the model?<br>-How does the model allow for specific inputs and outputs to be tested – for example – insert a tariff to get the required subsidy? Insert a target IRR to obtain a certain minimum tariff, etc | No tab for outputs –<br>Tool does not provide for sensitivity analysis | The model allows to insert tariff to get the required subsidy and to insert a target IRR to obtain a certain minimum tariff. | Outputs include:<br>a) Tariffs – various structures<br>b) Financial Performance Metrics<br>Sensitivity - A summary of the core variables is provided and the user is allowed to increase or decrease these core variables to see how it would change tariffs. The user can create a best-case scenario, expected case scenario and worst-case scenarios. Results of the multiple scenarios may be compared using the "copy" and "paste special - values" | -The tariff outputs are provided in Tariff Calc tab as Tariff in SLL/kWh (i.e. the conventional kWh tariffs structure)<br>-The tool does not have a scenarios section | The tools outputs are the three tariff structures – Average PAYG tariff, Average Flat Tariff, Time of Use Tariff. The tool also produces various graphs<br>-The tool does not provide for sensitivity analysis; It does not have a specific provision for testing various inputs and outputs |

| 6. Lessons learned from using the tariff tool | | | | | |
|---|---|---|---|---|---|
| | Zambia | Tanzania | Kenya | Sierra Leone | Nigeria |
| 6.1 What are the challenges encountered so far in using your tariff tool? | Tool was used in 2019. Most of the consumers did not comment on the tariff. Developer asked for a non-cost-reflective tariff below the grid tariff | The model contains complicated links that are difficult to follow | Challenges include:<br>-How to treat grants/ subsidies in tariff tool<br>-Difficulty in assessing prudence/efficiency of costs due to lack of adequate data for benchmarking<br>-Conflicting objectives (affordability vs | | -Community may not be sophisticated enough to interrogate their tariff.<br>-Some places where these operators work are very remote without network<br>-Regulatory environment / ESIA cost is very high. The Commission, the |

| 6. Lessons learned from using the tariff tool | | | | | |
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| | Zambia | Tanzania | Kenya | Sierra Leone | Nigeria |
| | | | operational efficiency vs fair return to minigrid developers) in determining RAB<br>-No clear performance indicators to compare various minigrids | | Federal Ministry of Environment and other stakeholders reviewed the ESIA for mini-grid and substantially reduce the cost to make it reasonable considering the capacities of mini grids and their environmental requirement.<br>-Developers have challenges getting long term funding/loans |
| 6.2 How do you propose to address the above challenges | | The model should be simple and straight forward to ease the tracing process | 1.Continuous assessment and improvement of the tariff tool so that it captures all investment dynamics for sustainable minigrid development.<br>2.Benchmarking analysis to ensure efficient costs are determined. | | The feasibility studies stage requires developer to hold consumer enlightenment and form a Power Consumer Committee which is supposed to be enlightened members of the Community. The Committee can also consult/contact the Commission for clarification and explanation on the tariffs and other issues concerning the mini grid |
| 6.3 What/if any are impending changes to the way you currently deal | The tool needs to be updated to align with the new Electricity Act | -Impending changes to mini grids tariffs approval including the tariff similarity i.e. mini grids | The social principle is to reallocate costs among customers to safeguard vulnerable groups but at | EWRC has switched to MYTO as the last tariff approval by the Regulator was based on MYTO (5 | Provide online application tools and online monitoring system |

| 6. Lessons learned from using the tariff tool | | | | | |
|---|---|---|---|---|---|
| | Zambia | Tanzania | Kenya | Sierra Leone | Nigeria |
| with mini grids tariffs approval<br>-What is the general social principle behind tariff setting in the country? | The donor/developer of the mini grid handed over to a private operator. The operator wants a transition to cost-reflective tariffs | tariff should be similar to National grid tariff.<br>-The general social principle behind tariff setting include being cost reflective tariff that is affordable. | the same time ensure the overall tariffs cost reflective | years). MYTO preferred because regulator wants to save time, for simplicity and accuracy. MYTO will guide tariff settlements going forward | |
| 6.4 Any other comments on the mini grid tariff tool. E.g., # of projects implemented, deviations, can applicant add extra tabs for specific situations? etc | None | Nil | 1. The mini grid tariff tool has enhanced regulatory efficiency by ensuring consistency, predictability, comparability.<br>2. Authority has approved over 10 minigrid tariffs using the standard tariff tool | If there is need for adjustment the provision is made in the model. The tool will be locked (password protected) in the next application | -No information on whether costs are reasonable. NERC to get a range from market survey on equipment cost<br>-NERC wants AFUR to have a compendium of project data to guide on level of efficiency, level of tariffs, etc. |

## 12.2 List of Stakeholders Consulted

| **List of stakeholders interviewed and dates of consultation:** | | |
|---|---|---|
| Stakeholder Group | Organization | Date of Interview |
| 1. Regulator | ERB Zambia | 17 June 2021 |
| 2. Regulator | EWURA Tanzania | 18 June 2021 |
| 3. Regulator | EPRA Kenya | 21 June 2021 |
| 4. Regulator | EWRC Sierra Leone | 22 June 2021 |
| 5. Regulator | NERC Nigeria | 21 July 2021 |
| 6. Donor/Investor | FCDO | 05 July 2021 |
| 7. Investor | Infraco Africa | 07 July 2021 |
| 8. Ministry of Energy | Zimbabwe | 09 July 2021 |
| 9. Donor/Investor | SE4All (Universal Energy Facility) | 09 July 2021 |
| 10. Investor | CAMCO/REPP | 13 July 2021 |
| 11. Developer | Credcent | 13 July 2021 |
| 12. Investor | Cross Boundary | 14 July 2021 |
| 13. Investor | Acumen Fund | 14 July 2021 |
| 14. Developer | Ensol | 15 July 2021 |
| 15. Developer | PowerGen | 15 July 2021 |
| 16. Ministry of Energy | Rwanda | 15 July 2021 |
| 17. Developer | Engie | 16 July 2021 |
| 18. Developer | Renewvia Energy | 16 July 2021 |
| 19. Donor | GIZ | 28 July 2021 |
| 20. Consultant | Inensus (GMG Help Desk) | 28 July 2021 |
| 21. Developer | Standard Microgrid | 03 August 2021 |
| 22. Developer | REI-Cameroon | 03 August 2021 |
| 23. Ministry of Energy | Uganda | 10 August 2021 |
| 24. Ministry of Energy | Burkina Faso | 20 August 2021 |
| 25. Regional Economic Community (REC) | COMESA | 24 August 2021 |
| 26. Ministry of Energy | Ethiopia | 06 Sept 2021 |

Note: The consultations were very successful with response rate of stakeholders contacted of more than 82%, which is an excellent return.