



UNLOCKING AFRICA'S MINI-GRID MARKET GUIDELINES SUMMARY

USAID SCALING UP RENEWABLE ENERGY PROGRAM
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GUIDELINES SUMMARY

PROJECT PURPOSE AND OBJECTIVES

The development of infrastructure in Africa is an integral part of the African Union (AU) Agenda 2063. The Agenda aims to achieve inclusive socio-economic development, which requires adequate electricity infrastructure at the continental, regional, national and local levels, including rural areas. Electricity is a prerequisite for economic development, and it improves social infrastructure such as health, education and financial services.

Sixty percent of Africans live in rural areas, only about 5% of which have access to modern electricity services. The lack of service is primarily caused by sparse settlements, low economic activity, distance to an existing grid and low population density.

African policies have focused on expanding grids in rural, peri-urban, and urban areas, with an emphasis on increasing national electricity grid coverage. As renewable energy generation technologies have become more affordable and efficient, mini-grids offer a viable alternative to grid expansion. They can bring electricity to millions living in rural and remote settlements with concentrated inhabitants while standalone solar home systems can be used to target areas with dispersed habitats.

Private sector companies are increasingly investing in mini-grids in Africa's rural areas, bringing innovative technology and financing solutions, dynamic business operating tools, and energy demand stimulation to improve their revenues and grow local economies. However, mini-grids face more challenges than their larger national utility counterparts.

Some of these barriers stem from imbalance in subsidy allocation, governments' mandate for tariff parity between off-grid and on-grid power consumers, and lack of a supportive regulatory environment for mini-grid project developers.

This "Unlocking Africa's Mini-Grid Market" study was funded by Power Africa, through USAID's Scaling Up Renewable Energy (SURE) project. It will build on the mini-grid work of the African Union Commission / Department of Infrastructure and Energy (AUC/DIE) and the European Commission (EC). The study's objective is to complement the AUC/DIE work by developing guidelines for policymakers and regulators around seven key themes: 1) off-grid policy, strategy and regulatory framework (also covering licensing and service territory allocation), 2) mini-grids business and financing models, 3) mini-grids interconnection terms, 4) mini-grids compensation mechanisms, 5) mini-grids gender inclusivity, 6) environmental and social impact of mini-grids, and 7) tariff calculations.

Countries define mini-grids differently in their policies, strategies and regulatory frameworks, as illustrated within this report. For the purpose of this analysis, we use the following definition: A mini-grid is any electricity supply system with generating capacity ranging from 1 kW to 10 MW (IRENA, 2016b) and can operate in isolation from the utility network's main grid. It comprises at least a power generation unit and a local distribution network and supplies electricity to more than one consumer. A micro-grid is 1 to 20 kW and is incorporated within the definition of a mini-grid.

This report assesses the current mini-grid policies, regulations and implementation strategies of ten countries across Africa (Democratic Republic of Congo, Ethiopia, Kenya, Morocco, Nigeria, Rwanda, Senegal, Tanzania, Tunisia and Zambia), as well as Cambodia and India. It examines their challenges, implementation successes and failures, and lessons learned.

The information provided by the AUC on mini-grids will help AU member states create an enabling environment for private sector engagement for the deployment and implementation of mini-grids to improve electricity access and rural productivity.

SCOPE OF THE STUDY

This study covers seven tasks/thematic areas:

1. **Off-grid Policy, Implementation Strategy, Regulatory Frameworks, Licensing and Service Territory Allocation:**

Many countries lack a rural electrification plan/strategy that includes specific targets for mini-grid deployment and detailed data to identify the electrification needs to inform the location of mini-grid sites. This study analyzes the process for allocating mini-grid service territories, obtaining licensing or authorization for mini-grids, licensing processes, and mini-grid territories versus national grid extension plans. It also provides lessons learned and guidelines on mini-grid licensing that integrate best practices.

2. **Business/Financing Models:**

Research shows that mini-grid projects are often not economically viable without government subsidies. However, the sustainability and effectiveness of existing subsidy designs present an ongoing challenge for governments and the private sector. This study assesses business and financing

models for mini-grid infrastructure development and highlights the success factors.

3. **Mini-grid Interconnection Terms:**

This study describes existing technical and regulatory options for interconnection when the national grid reaches a mini-grid service territory. It provides guidelines on the terms to be applied when interconnecting the national grid and a mini-grid. Included in mini-grid regulations, the interconnection terms provide clarity to mini-grid developers and guide their investment strategy, including

the choice of equipment type and the business model to be employed.

4. **Compensation Mechanisms:** Private companies in the mini-grid sector experience uncertainty over how they will be compensated when the national grid is expanded into their service territory before they have recouped their investment. This study examines case studies on the mechanisms and methodologies used in the 10 countries to articulate the principle considerations for compensation and guidelines for national mini-grid regulations. Compensation is one of the risks raised by investors and must be scrutinized during the due diligence of mini-grid projects.
5. **Gender Inclusivity:** Although men remain overrepresented in the power sector, women make important contributions in management and technical positions, including through work at leading mini-grid companies in the countries examined in this report. Especially in rural areas, women are the main beneficiaries of electrification access, which reduces time spent on housework and frees up time for education and income generating activities. This study explores best gender practices relevant to the mini-grid space.
6. **Environmental and Social Impacts of Mini-Grids:** Although mini-grids are recognized for their light environmental footprint and benefits for community health and safety, they also carry risks that could negatively impact communities and the environment. It is essential to consider environmental, health and safety (EHS) risks when determining whether to move forward with mini-grids. This study summarizes the direct and indirect environmental and social impacts of mini-grids.
7. **Tariff Calculation:** While tariffs are the core revenue generating stream for mini-grids, developers often face uncertainty because tariff regulations do not clearly guarantee cost recovery. In addition, without clear regulatory frameworks, customers are not protected and are vulnerable to high electricity tariffs. This study, conducted by the National Association of Regulatory Utility Commissioners (NARUC), inventoried tariff tools, developed an analysis report and gathered available users' manuals for publication on the AUC website. The Tariff Tools task does not follow the guidelines format below but will be provided in a [separate report](#).

KEY FINDINGS ON MINI-GRID DEPLOYMENT ACROSS AFRICA



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This section summarizes the general observations and trends on mini-grid policies and regulations for the 12 countries analyzed in this study.

I. OFF-GRID POLICY, IMPLEMENTATION STRATEGY, REGULATORY FRAMEWORKS, LICENSING AND SERVICE TERRITORY ALLOCATION

TRENDS

- Generally, the process for obtaining a mini-grid license is described in legislation. The required information and the site allocation (first come first served/unsolicited/concession) are indicated in the licensing regime. The legislation applies to both private and public-led models.
- Small capacity installations tend to be exempted from licensing but must still be registered.
- In almost all reference and case study countries, license conditions require adherence to national technical and service standards and prescribe the tariff and allocation of the service territory. A buy-out clause is also included for anticipated grid encroachment.
- Both solicited and unsolicited approaches should be considered in mini-grid site allocation with the choice made in accordance with the criteria set, nature and level of demand, etc.
- A first come first served approach is prevalent in countries that are trying to attract both foreign and domestic investment.
- Capacity building along the entire value chain is necessary to ensure systems' sustainability
- Technology choice should be flexible to ensure a least cost approach among other factors.

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Off-Grid Policy and Implementation Strategy

- Energy policy and rural electrification strategies should be flexible enough to find least cost rural electrification solutions including mini-grids and other off-grid electrification technologies.
- The government's institutional set-up should be structured to include clear oversight of off-grid initiatives to ensure systematic implementation.
- Capacity building should be strengthened along the entire value chain to enable effective implementation and sustainability.
- Rural electrification targets should be set, and performance monitored.
- Technological reviews should be undertaken carefully and systematically.
- Enabling investment environment (including incentives) should be enhanced and well elaborated to encourage strong and effective private sector engagement in this subsector.
- Stakeholder engagement with beneficiary communities, the private sector, civil society, academia, etc. should be conducted.
- Investment barriers – including capital requirements, tariffs, and subsidy requirements – should be examined to ensure the effective implementation of rural electrification strategies to include mini-grids.
- Different financing mechanisms and investment models should be assessed to inform decision-making.



Legal and Regulatory Framework

- It is important that the legal and regulatory framework is transparent, and that the regulations' requirements and obligations are enforced. This pertains to licensing for power generation and/or distribution and trading, economic regulation, obligations related to the utilities and other energy service providers.
- Regulatory frameworks need to include electricity pricing and describe the allowed business models and permitting procedures. It is important that regulations provide for a mini-grid license/permit that covers generation, distribution and sales of electricity to end-users.
- Simplified regulations for very small size projects can speed their deployment.
- There should be a legal framework that provides for a situation when the grid encroaches the MG service territory.
- It is important to have a legal and regulatory guidance on provision of incentives and subsidies.
- Streamlining licensing and permitting processes to minimize authorizing entities is key in facilitating investors.
- Developers need to be transparent (to the regulator) about their investment and financing sources and tariff calculation. This is important in protecting the end user consumers from tariff gouging.
- It is important that regulations state the threshold capacity above which the retail tariff must be regulated.



Licensing and Service Territory Allocation

- Site allocation/reservation approaches should be open to both solicited and unsolicited options following the criteria set forth including the nature and level of demand.
- A time-limited provisional license/registration/permit for site reservation or allocation should allow developers to carry out feasibility studies and seek funding for construction, but at the same time protects communities from being taken advantage of by developers.
- A concession agreement providing for occupation of the location and duration of the concession should be entered upon commissioning of the mini-grid and start of operations.

2. BUSINESS/FINANCING MODELS

TRENDS

- Business models are still evolving and there is ongoing experimentation to determine optimal mini-grid business models. The following areas are driving the development of viable commercial mini-grid business models:
 - Affordable tariffs that optimize average revenues per customer.
 - Increasing productive use of electricity.
 - Service quality and reliability of mini-grids as a source of competitive advantage over the main grid and solar home systems.
 - The off-grid power purchase agreement (PPA) is another promising business model but requires a fund at the beginning to absorb the difference between the feed-in tariff and the bulk tariff.
 - Innovative project finance that allows investors and lenders to provide long-term financing based on the cash flow generated by the mini-grid's assets. There is interdependency among business models, financing models and the regulatory regime. A commercially viable business model with certainty in revenue streams can unlock additional funding sources from long-term debt capital/project finance. The regulatory regime is important to providing the revenue certainty from tariffs.

Results-based financing (RBF) —a per connection or per kWh subsidy— paid to the mini-grid developer is vital to increasing universal access. Private investors favor RBF because governments and donors match private capital to de-risk mini-grid deployments. As private off-grid companies deploy new technologies and business models, the RBF subsidy is expected to decline over time as the economics of rural electrification improve and off-grid technology costs decrease with scale.



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Business Models

- Policy and regulations should allow an ownership model that protects property rights. Those property rights should be reflected in provisions for willing-buyer-willing-seller with commensurate compensation (i.e., should not be confiscatory) and based on best practices in the mini-grid sector.
- Policy and regulations should be flexible on operating models but issue hard coded operating standards, service reliability and safety standards among other mini-grid performance obligations.
- Regulators have an important role in setting the right tariff, which is an important business model success factor for a mini-grid developer – There is a delicate balance between customer needs, developer economics, and the socioeconomic requirements of the policymaker.
- Policy makers should support education of consumers on usage of electricity to stimulate electricity demand to catalyse maximize social benefit of mini-grid service areas and increase mini-grid revenue and sustainability.
- Policy and regulations should be flexible to embrace new business models as they evolve.
- Regulation should facilitate mini-grid operational sustainability.



Subsidies and Government incentives

- Mini-grids, like all prior rural electrification programs, will require government incentives and subsidies from other sources for capital and operating expenditure (CAPEX and OPEX).
- Subsidies and government incentives should be accessible to both public and private sector entities delivering rural electrification (grid expansion or mini-grid).
- Subsidies and government incentives extended to the private sector should be awarded via a competitive (tender and/or auction) process in line with the country's public procurement regulations to ensure transparency and value for money to the public.
- There should be clear accountability and independent results verifications of the outcomes of the subsidies and government incentives for them to be accessed by the private sector
- The subsidies and government incentives should be targeted, reduce over time and be time-limited with an endpoint, upon which they are to be replaced by electricity productive uses and social enterprises that can lift the communities out of poverty.
- Government incentives should not be about government paying private sector, but about equity, to treat all sources of energy systems the same (i.e., energy technology neutrality in incentive dispersal)



Financing Models

- Government policy and regulations on tariffs that ensure cost recovery are key to unlocking other sources of funding, especially debt and project financing that will give mini-grids access to required long term financing.
- Adjust regulatory frameworks to embrace new funding initiatives like guarantees and blended finance to unlock capital for the mini-grid sector. The regulatory framework could evolve to support the economics of these new financing models

3. INTERCONNECTION TERMS

TRENDS

- There are many issues that policymakers, regulators and utilities have to address when creating favorable mini-grid interconnection regulations. The grid codes of most countries are designed around the compliance of large-scale utility power plants interconnecting with the grid at a point of supply where a utility company meters electricity that the power producer sells. However, mini-grids are much smaller and often distribute power to customers behind their point of supply. The smaller scale of mini-grids and the low consumption of their customers can make it unprofitable for private mini-grid developers and operators to comply with current grid code requirements. Important findings from the case study countries and literature include:
 - Minimize country-specific standards compliance cost through the adaption of regional or international standards, like the Institute of Electrical and Electronics Engineers (IEEE) 1547, into the grid code.
 - Allow mini-grids to intentionally island (i.e., temporarily disconnect from the grid and operate independently), provided they follow recognized standards, for example IEEE 1547.4-2011.
 - Create a tiered structure for grid code compliance that allows small-scale mini-grids to meet fewer interconnection regulations than large-scale utility power plants.
- Design a streamlined interconnection application process with minimal approving authorities; harmonize the application of rules across approving authorities; and ensure both the applicants and approving authorities have deadlines for completing tasks. Smaller mini-grids should be able to complete the application process faster than larger mini-grids.
- Standardize the costs for processing an interconnection application (e.g., utility administration costs associated with engineering inspections and document handling) and make them transparent and as low as possible. In general, applicants are responsible for hardware, labor and testing for commissioning up to their point of supply. The option should exist for applicants to pay for grid studies, hardware upgrades and utility supervision beyond the point of supply should they wish to avoid potential delays.

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Mini-grid Interconnection Terms

- Larger mini-grids should be compatible with the grid, but requirements should vary with mini-grid size.
- Regulations should be based on national or regional standards that minimize country-specific compliance costs for mini-grid developers and operators.
- Intentional islanding of a mini-grid should be allowable if international standards are followed.
- The application approval process for interconnection should be straightforward and appropriate.
- Ensure interconnection application costs and duration are predictable for the applicant.
- A process should be in place to resolve disputes between the utility and applicant.
- Grid stability analyses should be required as part of the interconnection application process for applicant with variable renewable energy generation.

4. COMPENSATION MECHANISMS

TRENDS

- The prospect that the national grid can extend into a mini-grid service area has always introduced an element of uncertainty in private investors' ability to realize a return on their off-grid investment. Some country governments are trying to devise different mechanisms and approaches to ensure investments are not discouraged. Mini-grid permits and licenses should provide adequate legal protection for private investors and enable mini-grid owners to seek compensation for the cost of privately financed assets and any lost revenues when a mini-grid encroaches on their service area. Governments should also provide guidance on how the mini-grids might eventually be integrated into the national grid.
 - Most study countries have regulations either in place or in draft form that provide for compensation; however, India and the DRC do not. In Senegal, regulations provide for the transfer of assets, compensation is not mandatory, and no methodology is described for determining the compensation amount. It is hoped that the regulations currently under development will plug this gap.
 - While several countries' compensation policies are described in regulations, they have not been applied in practice. The Africa Mini-grids Developers Association (AMDA) stated that the “compensation topic is much less important than what people think, mini-grids go to areas where the grid is not anticipated to arrive that soon; mini-grids are likely to work closely with the utility and even in parallel, like the case of Powerhive in Kenya which provides power service almost ‘under the Kenya Power and Lighting Company (KPLC) grid.’”¹ Still, it is important for regulations to provide for compensation and specify a valuation model that is reasonable.

¹ “Under the grid” is an expression that describes communities who live within the distribution company service area, but receive unreliable, intermittent and/or low-quality power.

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Compensation Mechanisms

- It is important that mini-grid regulations address the anticipated encroachment of the main grid into the mini-grid service territory. The regulations should:
 - Provide guidance on models of how the mini-grids might eventually be integrated into the national grid.
 - Provide for certainty in compensation as appropriate.
 - Specify the eligibility criteria for such a compensation.
 - Specify a credible valuation model for determining amounts eligible for compensation.
- Several compensation models can be considered based on best practices and the models for integration of the mini grid into the national grid.
- It is important to know where the money will come from to pay the compensation.
 - There is a need to set aside a guarantee fund for compensation.
 - The buyout clause needs to be backed by that guarantee fund, and the fund would also provide insurance for foreign exchange and political risks.
- Regulators should require better communication on the expected grid expansion plans. Utilities should develop electrification plans that clearly define the on- and off-grid territories to comply with said regulation.

5. GENDER INCLUSIVITY

TRENDS

There are several commonalities across three countries examined: Zambia, Colombia and Rwanda.

- All have policies and strategies in place for gender mainstreaming in the energy sector but are at varying stages of developing and implementing specific actions and strategies to improve gender equality and women's empowerment. In addition, they have begun the process of embedding gender mainstreaming in mini-grid specific policies and strategies.
- Gender focal points (GFPs) are in place within ministries of energy, which are tasked with developing and implementing gender mainstreaming strategies and plans. There are varying levels of responsibility assigned to GFPs, and in some instances there is more accountability at top senior management levels to ensure the implementation of gender action plans.
- While there are varying stages of development of action plans in place to accompany gender policies in the energy sector, resources have not been allocated to implement planned actions.
- These countries are at the beginning stages of planning how to address gender mainstreaming related to mini-grids and renewables.
- There is increasing emphasis on the importance of gender-descriptive and sex-disaggregated data collection, gender analysis, and gender assessments as fundamental to formulating strong evidence-based gender mainstreamed policies and action plans.

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Gender Inclusivity

- Energy policies, strategies, directives, and action plans should be updated by policy-makers to mainstream gender with concrete actions at the sector level, as well as within specific mini-grid policies and strategies, and should include policy and regulation enforcement tools, such as gender parity quotas. This should be informed by a gender analysis or assessment and should be accompanied by a gender mainstreamed monitoring, evaluation and learning (MEL) plan and budget, with gender expertise engaged for successful implementation.
- Action plans should be specific, strategic, and practical, and based on sound gender analysis. Two resources can be used to support this: NARUC Practical Guide to Women in Energy Regulation and USAID Energy Equality: the importance of integrating gender equality in national energy policies and frameworks.
- Government policies should require that mini-grid developers conduct project-specific gender analysis and inclusive, equitable community engagement during mini-grid feasibility to ensure developers meaningfully address gender equality in the design, service delivery, and workforce of all mini-grid developments, with an emphasis on empowering women to engage in income-generating activities throughout the entire supply chain.

6. ENVIRONMENTAL

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Environmental and Social Impact of Mini-Grids

- It is important to consider environmental, health and safety (EHS) impacts of mini-grids in project design, implementation and monitoring.
- Risk mitigation measures should be designed to ensure project sustainability and regulatory compliance.
- For developers of small power projects, ESIA's are costly and complex. Therefore, governments should assist developers to fulfill this requirement by providing financial support. Alternatively, governments can undertake ESIA's in one area where the generating source is the same and covers several concessions. Developers can then be included in such ESIA's and not have to incur costs to complete them.
- Mini-grid systems should be built and installed by trained professionals and implemented in accordance with manufacturer requirements and best practices in electrical engineering. End users should be trained in the correct use of the equipment before using it so that they understand its limitations, proper usage and all relevant safety requirements. This is particularly important in areas that have limited experience with electricity.