



Promoting Energy Access through a Quality Assurance Framework for Isolated Mini-Grids

Mini-Grids to Support Universal Energy Access

Providing clean and affordable energy services to the more than 1 billion people globally who lack access to electricity is a critical driver for poverty reduction, economic development, improved health, and social outcomes. More than 84% of populations without electricity are located in rural areas where traditional grid extension may not be cost-effective; therefore, distributed energy solutions such as mini-grids are critical. The International Energy Agency projects that to achieve universal energy access by 2030, more than 40% of total investments must be directed toward mini-grids.¹

A Key Barrier to Scaling Up Mini-Grids

While mini-grid technology is mature, mini-grid development is ad-hoc and fragmented. This creates a major barrier to the scale-up and aggregation needed to lower transaction costs and attract the commercial financial investments that are required for rapid and widespread deployment. Developing business models that will allow this scale-up remains challenging. To be successful, any business model for commercially viable mini-grids must address the needs of three key stakeholder groups:

- **Customers:** Need a guarantee of service that they can afford and are willing to pay for
- **Power suppliers:** Need to be able to guarantee a rate of return to their investors while covering all operational costs
- **Investors:** Need to be confident of the risks they are taking

Business models for utilities in mature energy markets work because the roles and relationships between these three stakeholder groups are well-defined. In the case of rural electrification, this utility model breaks down as a result of three main challenges:

- The high cost of power provision to remote customers
- A lack of consistent cash flows from customers to the power supplier

- Poorly understood investment risk profile due to the small number and high variability of projects

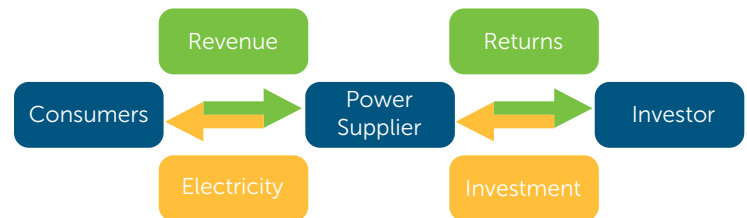


Figure 1. Utility business model in mature markets.

A Quality Assurance Framework for Mini-Grids

To address the root challenges of providing quality power to remote consumers through financially viable mini-grids, the Global Lighting and Energy Access Partnership (Global LEAP) initiative of the Clean Energy Ministerial and the U.S. Department of Energy have teamed with the National Renewable Energy Laboratory (NREL) and Power Africa to develop a [Quality Assurance Framework](#) (QAF)² for isolated mini-grids. The framework addresses both alternating current (AC) and direct current (DC) mini-grids, and is applicable to renewable, fossil-fuel, and hybrid systems.

The QAF for mini-grids aims to address the challenges of providing safe, quality, and affordable power to remote customers via financially viable mini-grids. It is focused on two key frameworks:

- (1) **Levels of service framework:** Defines a standard set of tiers of end-user service and links them to technical parameters of power quality, power availability, and power reliability. These levels of service span the entire energy ladder, from basic energy service to high-quality, high-reliability, and high-availability service (often considered “grid parity”).

¹ International Energy Agency, *Energy Poverty: How to Make Modern Energy Access Universal* (Paris: IEA, 2010).

² Ian Baring-Gould et al., *Quality Assurance Framework for Mini-Grids* (Washington, DC: U.S. Department of Energy, 2016).

- (2) **Accountability and performance reporting framework:** Provides a clear process of validating power delivery by providing trusted information to customers, funders, and/or regulators. The performance reporting protocol can also serve as a robust monitoring and evaluation tool for mini-grid operators and funding organizations.

The QAF aims to provide a similar structure and transparency for isolated mini-grids akin to that offered by successful utility models, while also reflecting the range of service levels—from basic energy services to grid-parity service—required to meet the needs of various segments of the off-grid consumer base. The framework's goal is not to set a specific standard level of service, but rather to ensure truth in advertising by specifying a range of service levels and providing assessment and reporting mechanisms that can be used to determine whether an agreed-upon level of service is delivered.

The framework will lay the foundation for sustainable business models in the mini-grid space by clearly defining the roles and relationships of the various stakeholders. It will provide customers with a guarantee of service that they can afford, power suppliers with a guaranteed rate of return, and investors with confidence about their investments.

The Benefits of Quality Assurance: Unlocking Investment and Scaling Up Deployment

The QAF can drive improved sustainability, greater market confidence, and expanded investment in this important off-grid sector by achieving the following:

- **Facilitating safe, quality, and affordable delivery of power through mini-grids.** The QAF levels of service ensure basic safety while matching service delivery to customer needs and ability to pay. This in turn can help strengthen a project's revenue flows and optimize its system design and operability, which will increase the project's financial viability.
- **Providing a formalized, common standard for classifying energy consumers.** QAF levels of service allow a common basis for the assessment of community energy needs, which can streamline community assessment and site selection efforts, and a common basis for facilitating improved forecasting of energy needs across a community, region, and nation.
- **Facilitating aggregation of mini-grid projects and unlocking private investment.** A common classification system for customers and level of service provided, supported by the QAF's standard monitoring and performance reporting protocols, will make it easier to bundle projects together, facilitating access to larger-scale finance at more competitive rates. Data generated from implementation of the QAF can be a source of robust sector-wide market intelligence on the typical technical and nontechnical characteristics of mini-grid systems (e.g., payment collection rates, customer characteristics, and electrification rates), which over time will increase investor confidence and lower the risk profile of mini-grid power

systems, further decreasing barriers to private investment and driving scale in the sector.

- **Informing policy and regulatory frameworks while helping to standardize regional rural electrification deployment efforts.** Defining a standard set of customers and an accountability-based reporting framework forces structure on larger rural electrification efforts using mini-grid power systems, providing regulatory clarity while hopefully minimizing the regulatory burden by providing a simple set of reporting requirements tuned to specific project stakeholders. Defining specific customer reporting also leads to the implementation of simple consumer protections, resulting in a better consumer service that will be reflected in willingness to pay for a high-quality energy service.

Demonstration Projects

Demonstration projects will be identified to test and verify the QAF beginning in mid-2017 in partnership with the Power Africa Beyond the Grid Program. Power Africa and NREL would like to partner with mini/microgrid developers in Africa for the demonstration projects. These pilot projects will enable refinement of the QAF and support system development, commissioning, and operations, as well as development of additional QAF documents. The pilots will also benefit mini/microgrid developers by improving existing and future projects, establishing technical consistency, and increasing profits. Documentation and successful adoption of these principles will support the bundling of microgrid projects, improving the investment profile for future projects and the availability of financing. Implementation projects will also be developed with national governments and investor or funding organizations to apply the QAF to the projects or programs they support to facilitate standardization and bundling.

For More Information

For more information on the QAF, including a free overview webinar and technical assistance, please visit [the Clean Energy Solutions Center](#).

Collaboration and Feedback

Stakeholder engagement is critical for both the development of QAF concepts and the demonstration of results. Ongoing engagement from across the mini-grid sector—including energy service providers, developers, investors, regulators, donors, and nonprofits—is encouraged and is essential for QAF adoption. Stakeholders are encouraged to contact the demonstration project team for further information and to discuss possible collaboration.

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