

Quality Assurance Frameworks for Component Based Solar Home Systems

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Introduction

Electricity access and security is one of the key factors that a country must possess to ensure proper future progress and wellbeing of its nation. In 2016, 940 million people, representing 13% of the world's population, did not have access to electricity (Ritchie & Roser, 2020). This number is declining as the renewable energy market continues to grow. In 2007, Lighting Africa was launched to support the rapid scale-up and delivery of modern off-grid lighting to Sub-Saharan Africa. One of its objectives was to develop a Quality Assurance Program for the plug and play solar home systems. The project then expanded to other areas, and was rebranded as Lighting Global. By the end of 2019, over 250 million people had benefited from using Lighting Global quality verified solar products (Lighting Global, 2020) . However, as the project is still ongoing, it is important that reliable quality systems are being installed.

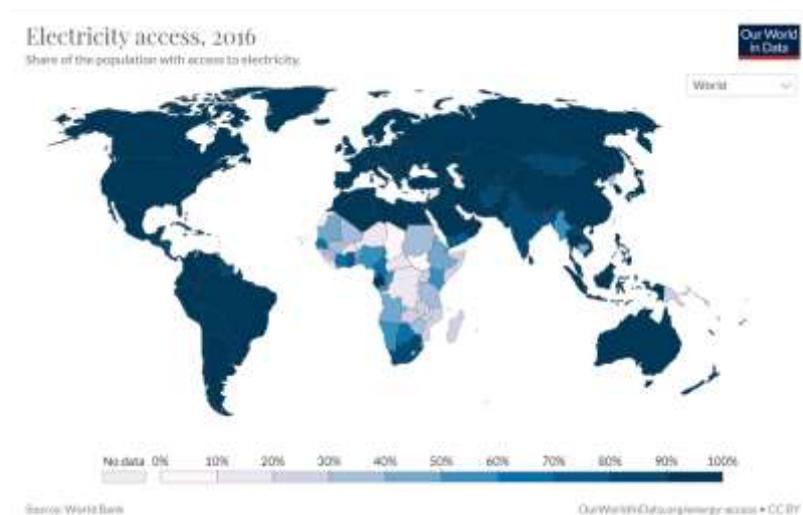


Figure 1 – World's Electricity access (Ritchie & Roser, 2020)

The author's company, Global Sustainable Energy Solutions (GSES), won a contract in November 2018 with the Ugandan Rural Electrification Agency (REA) to develop a Quality Assurance Framework for Component Based Solar Systems. The project started in February 2019 and will be completed in August 2021. This paper outlines the deliverables of the project and what is included in the Quality Assurance Framework.

Project Overview and Deliverables

The Energy for Rural Transformation (ERT), is a Government of Uganda – World Bank supported programme that started in 2001 to promote the transformation of rural areas in Uganda. The third

phase of the ERT programme focuses on increasing access to electricity in rural areas of Uganda through on-grid and off-grid technologies.

Under ERT-3, the Uganda Energy Credit Capitalisation Company (UECCC) is managing a line of credit and guarantee facility to promote the deployment of quality-verified off-grid solar systems. The Quality Assurance Framework (QAF) developed by GSES is supporting this objective.

GSES had five major deliverables within the project:

1. Developing the interim quality assurance framework to support the existing UECCC managed loan facility.
2. Undertake the implementation of this interim framework by: assessing the individual system components and system designs; evaluating installers and installed systems of 10 companies that are applying to obtain finance through the UECCC.
3. Develop the interim framework into a sustainable long term quality assurance framework through identifying the structure of a committee/organisation that would continue to oversee (or manage) the framework on an ongoing basis.
4. Build the capacity of Uganda National Bureau of Standards (UNBS) or a designated third-party to assess the quality of components, design of systems, warranty terms and quality of installations.
5. Evaluate the current capability and identify gaps of the UNBS laboratories to support testing of component-based solar products

Components of the Quality Assurance Framework

When the QAF is implemented, companies within Uganda must supply and install solar systems in accordance with the requirements of the QAF. In summary, the QAF includes:

- the company requirements;
- component (products) standards;
- installer requirements;
- component warranties;
- complaints and sanctioning procedures; and
- outlines the responsibilities of the REA, UNBS and Electricity Regulatory Authority (ERA) in implementing the framework.

The products standards refer to existing International Electrotechnical Commission (IEC) and Underwriters Laboratories standards. However, for the QAF to be successful, guidelines/standards are required for the design and installation of the systems and professional training requirement for designers/installers. A review of the existing training capability in Uganda was completed to ensure proper installer requirements are set. Two guidelines were developed:

- Off-Grid PV Systems - Design Guideline; and
- Off-Grid PV Systems - Installation Guideline.

The installation guideline has been developed into a Draft Code of Practice which when finalised will be a Code of Practice published by the UNBS.

Company Requirements

The company requirements specified the required legal status of the company and required the company to:

- only use components within their solar systems that have been tested and certified against the required standards;
- design and install systems in accordance with the two guidelines (and Code of Practice when released);
- only use installers that meet the requirements specified in the QAF; and

- provide end user training at the completion of each system installation.

Component Standards

The individual system components to be used in component-based solar systems must comply with the specific component standards and performance requirements for the following components:

- Solar Modules,
- Batteries,
- Solar Charge Controllers, and
- Inverters.

The company is required to provide verifiable test certificates to the UNBS confirming that the major components used in the system comply with the relevant specified standards. This shall be undertaken by a testing laboratory accredited to ISO/IEC 17025: General Requirements for the Competence of Testing and Calibration Laboratories. Additionally, the laboratory shall have ISO/IEC 17025 accreditation for the particular standard / test method used which will be confirmed by the UNBS.

Installer Requirements

The installer requirements of the QAF are as follows:

- All installers as a minimum must have successfully completed the *Short Course in Solar Photovoltaic Technology (Stand-Alone Systems) Level 1* as detailed in the “Assessment and Training Package for Solar Photovoltaic Electrician” that was developed by the Directorate of Industrial Training (DIT) in conjunction with the Nakawa Vocational Training Institute under Business, Technical, Vocational Education and Training (BTVET) programme under the Ministry of Education and Sports.
- Experienced installers should either complete this course or be assessed by a training centre that they have all the skills identified in this course. Within quality training programs this process is often called Recognition of Prior Learning or RPL.
- All installers after 2 years’ experience shall apply and obtain their Z Class Permit provided by the Electricity Regulatory Authority.
- In addition, all installers shall complete and achieve a pass mark of 75% in a written multiple-choice assessment based on the Off-Grid Systems- Installation guidelines.

Warranties

The minimum warranty is 2 years on the complete system installation and on each of the individual components.

The photovoltaic modules shall be warranted to provide their rated output at standard conditions within $\pm 10\%$ for a minimum of 10 years under the operating conditions at the sites. The modules shall be warranted against physical defects for a period of at least 5 years following installation.

The responsibility to carry and honour these warranty provisions is borne by the company and applies even if the product manufacturer fails to honour the warranty and/or the company manufacturing the product no longer exists.

Complaints and Sanctioning Procedure

The QAF will also include a procedure on how to process complaints for companies who fail to abide with the framework requirement. The complaints will be processed by the ERA as they have the regulatory mandate to enforce non-compliance with the WAF.

The complaints could be submitted by:

- the UNBS;
- the system owner; or
- Other industry stakeholders.

The QAF detailed step by step how complaints should be submitted and processed depending on who submitted the complaint with respect to the company and what sanctions should be taken if the complaint is found to be justified.

Lessons Learned from Project Implementation

In implementing the Interim QAF the following issues were identified, and lesson learned:

- the companies were having difficulty in obtaining the required test certificates for the various products and provided many irrelevant documents, hence further training and instructions were provided;
- one of the test certificates was a fake and this emphasised why it was important to verify the certificates which led to training courses on this for UNBS along with detailed step by step processes on how to verify the certificates; and
- further training for companies is required on how to follow the recommended design guidelines.

Unfortunately, due to the pandemic the inspection of the systems have not been completed yet.

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