

Lighting Global Quality Assurance Framework

Past, Present, and Future Support for the Off-Grid Energy Market

Version 3
July 2015

Executive Summary

This document **describes the framework and intentions of the Lighting Global Quality Assurance (QA) program**. It also explains how Lighting Global currently interacts with the regional programs (i.e. Lighting Africa, Lighting Asia and Lighting Pacific) and how the Global and regional programs interact with manufacturers, distributors, customers, and other stakeholders. It concludes by **identifying challenges that the QA program should address to respond to changing market conditions and the actions the program is taking to address these challenges**. These challenges and actions have been updated in this version to reflect the state of the program and the market in July 2015.

The Lighting Global QA program is designed to support the development of markets for modern off-grid lighting and energy systems. The program provides buyers with reliable technical information and connects them with manufacturers and sellers of quality-verified products. Our approach includes testing and verification of quality and performance and engagement with the diverse and fast-growing market for modern off-grid lighting and energy systems, through stakeholder consultation and field research. The QA program has thus far supported pico-powered lighting and energy products that include solar modules up to 10 watts (W) in size, and it is currently in the process of expanding to support “plug-and-play” direct current (DC) solar home system kits that use solar modules ranging from 10 W to 100 W in size.

The QA program has five **guiding principles**, driven by the needs of the market:

- **Affordability:** Seek an appropriate balance between quality and affordability for a market consisting primarily of low-income off-grid consumers in Africa and Asia.
- **Diversity & Innovation:** Allow for product diversity in technology, utility, and price; encourage innovation by using non-prescriptive, performance-based metrics and goals.
- **Rigor:** Develop rigorous test methods that can be carried out using reasonably low-cost instruments; provide technically valid test results that can be accepted globally.
- **Stability:** Maintain stable and transparent QA policies so stakeholders know what to expect.
- **Insight:** Effectively communicate key product quality and performance information so buyers can make informed purchasing decisions.

The QA framework has actively supported the market for modern off-grid lighting and energy systems since 2009. Today, in 2015, the framework includes a third-party product testing and verification program, product quality standards, a standardized specifications sheet (SSS) communication tool, the Technical and Eco-Design Notes series, and an IEC Technical Specification (TS 62257-9-5) that helps to enable wider adoption of the framework.

As the QA program enters its sixth year, Lighting Global continues to work on **improvements** to the framework, ensuring its continued relevance for the rapidly changing off-grid solar lighting and energy products market. Key recent activities aimed at improving the program include the following:

- **Shortening the testing process:** Lighting Global is in the process of implementing a new, faster framework for product quality verification called the Accelerated Verification Method (AVM). This will be an optional, alternative quality verification pathway for eligible manufacturers that is faster than the standard Quality Test Method (QTM) pathway, while maintaining the strength and value of Lighting Global QA.
- **Expanding the scope:** Lighting Global is in the process of extending support to “plug-and-play” direct current (DC) solar home system kits from 10 W to 100 W in size. Larger systems are increasingly a priority for the off-grid energy systems market. These systems have the capacity to support a range of appliances beyond lighting and mobile phone charging.
- **Improving communication to buyers:** Lighting Global recently implemented a policy on performance reporting requirements ensuring that all quality-verified products going forward will display key performance information on their packaging. These reporting requirements, along with other activities, will help increase the ability to communicate to buyers across the supply chain.
- **Preparing for the future:** Lighting Global is working to expand the network of commercial test laboratories, engage with key stakeholder organizations, and develop a strategy and business model to ensure effective quality assurance services are maintained on a sustainable basis beyond the end of programmatic World Bank Group funding for Lighting Global.

Program History

Institutional Support: The Lighting Global quality assurance (QA) program was originally developed in support of Lighting Africa, a joint program of the World Bank and the International Finance Corporation (IFC). Lighting Africa activities began in September 2007 with the aim of improving access to clean, affordable lighting in Africa. Since then, QA continues to be a collaborative effort that is executed by internal World Bank and IFC staff, external consultants, and a broad set of stakeholders who contribute to and adopt the principles of the QA framework. With the launch of the Lighting Asia/India program in 2012, the Lighting Global program was spun off from Lighting Africa to administer the common, global aspects of the Africa and Asia initiatives, including the QA program. Lighting Global is now supported through collaboration between the International Finance Corporation, the World Bank, and the United States Department of Energy. Lighting Global currently supports program activities in more than 15 countries through Lighting Africa, Lighting Asia, and the Lighting Pacific.

Snapshot of Activity: Since the launch of Lighting Africa, the QA programs’ network of test laboratories, currently, consisting of labs in the U.S., Germany, India, Kenya and China, have tested over 150 products using the full Quality Test Method, 95 of which have met the Quality Standards and received program support. Many additional product tests have been conducted using the Initial Screening Method and the Market Check Test Method. This work has helped enable over 10 million units of quality-verified products to be sold in Africa, Asia and the Pacific through December 2014. In April 2013, the test methods developed by Lighting Global were published by the International Electrotechnical Commission (IEC) as IEC/TS 62257-9-5, Edition 2.0. The QA framework utilized by Lighting Global has been adopted by a number of governments and programs, including the Kenya Bureau of Standards, a working capital loan facility managed by the Development Bank of Ethiopia, the Infrastructure Development Company, Ltd. (IDCOL) of Bangladesh, the Alternative Energy Promotion Centre (AEPC) of Nepal, and others. It is anticipated that ECOWAS, which includes 15 member countries in West Africa, will adopt a quality assurance framework that is harmonized with the Lighting Global QA

framework in the coming months. Lighting Africa and Lighting Global have also held two Outstanding Product Awards competitions, in 2010 and 2012. In addition to the QA activities, Lighting Global has published a series of 25 Technical and Eco-Design briefing notes, providing detailed technical and environmental insights into product components used by the off-grid lighting industry. Further, Lighting Global has conducted field research regarding product availability in the market, consumer preferences for light output and run time, and service and maintenance issues relevant to the off-grid lighting industry. As noted above, it is also in the process of expanding the framework to cover SHS kits and of making a series of improvements to the existing QA program.

Lighting Global QA Program Today

Quality assurance (QA) is a key component of Lighting Global and its associated regional programs. The widespread adoption of the Lighting Global QA framework provides benefits to multiple stakeholder groups:

- **Manufacturers** can have their products tested and verified through a single framework, thereby saving time and money,
- **Supply chain actors** (wholesale distributors, retailers, bulk buyers, financial institutions, etc.) can make more informed purchasing decisions and marketing campaigns, while only needing to understand one QA framework,
- **Standards agencies** benefit from adopting an internationally recognized QA framework that gives a high degree of legitimacy and alleviates the need for new in-country testing,
- **Consumers** have access to better quality products. Additionally, consumers can benefit from lower product prices, as companies can pass savings of reduced costs for QA verification onto customers.

As shown in Figure 1, the Lighting Global QA framework consists of three key main components: test methods and quality standards; testing and verification; and communication to stakeholders. These components are described in more detail below.



Figure 1. Structure and main components of the Lighting Global QA framework (based on a diagram prepared by Navigant Consulting, Inc., under activities sponsored by the U.S. Department of Energy’s Global LEAP initiative).

Test methods and quality standards

Lighting Global has developed four test methods to meet the unique needs of stakeholders in the market for off-grid lighting products. These methods are faster and less expensive (lower personnel and equipment costs) but less thorough than other established test procedures for lighting products. The test methods, summarized in Table 1, assess the performance of individual components such as the LED, battery, and PV module, as well as system-level metrics such as run time, physical ingress and water protection, and durability.

Table 1. Summary of key tests used by the Lighting Global QA Program for pico-products.

Component Tests	Sampling	<ul style="list-style-type: none"> Randomly selected from warehouse or marketplace
	Photometrics	<ul style="list-style-type: none"> Luminous flux (lumens—total light output) Standardized distribution (illuminance)
	Battery & Charge Control	<ul style="list-style-type: none"> Battery capacity (amp-hours) Protection (voltage cut-offs and durability)
	Solar Module	<ul style="list-style-type: none"> Power output (watts) Current-voltage characteristics (I-V curve)
System Tests	Full-Battery Run Time	<ul style="list-style-type: none"> Measured using standardized cycle (hours of operation)
	Solar-Charge Run Time	<ul style="list-style-type: none"> Modelled estimate (daily hours of operation after solar charging)
	Physical Ingress & Water Protection	<ul style="list-style-type: none"> Incorporates enclosure (IP class) and system-level protection (coatings, etc.)
	Durability	<ul style="list-style-type: none"> Drop test from one meter (pass/fail) Switch and connector durability Internal wiring and solder inspection Lumen maintenance Battery capacity loss after storage

The QA framework and test methods for pico-products (products with solar modules smaller than 10 W_p) have been institutionalized through, and are now based on, IEC/TS 62257-9-5, Edition 2.0, a Technical Specification published by the International Electrotechnical Commission (IEC). Publication of this document through IEC provides a common framework that can be used to enable widespread adoption of a harmonized quality assurance approach. The document was published in a way that enables revision on a reasonably frequent basis (i.e., every one to three years). This was done to help ensure that the quality assurance framework and test methods can be updated to meet the needs of a rapidly changing market.

As described later in this document, Lighting Global is in the process of developing a similar QA framework and test methods for larger plug-and-play solar home systems kits with solar modules that range from 10 W_p to 100 W_p. These methods include many of the same tests used for pico-products, but additionally assess the quality of the appliances and ports and evaluate key safety aspects associated with the larger batteries and higher currents in these systems.

Lighting Global currently uses three test methods, all of which are described in IEC TS 62257-9-5 and the draft Lighting Global Solar Home System (SHS) Test Methods:

- The **Quality Test Method (QTM)** is the flagship method for Lighting Global. The results are used to verify if products meet the Lighting Global Quality Standards, to verify manufacturers' claims, and to provide input information for the Standardized Specification Sheets that are published through the Lighting Global website. Having a quality-verified product is a pre-condition for manufacturers that wish to achieve Associate Status with the Lighting Africa, Lighting Asia and Lighting Pacific programs.
 - 18 product units are randomly selected from a warehouse at the product's assembly location or in the commercial market. (For SHS kit products, 16 product units are selected).
 - A sample size of 6 is used for most tests; Lighting Global aims to provide results from these tests in approximately 4 months from the time that samples arrive at the test laboratory. (For SHS products, a sample size of 4 is used).
- The **Initial Screening Method (ISM)** is an abbreviated version of the QTM that is designed to provide a lower cost and faster turnaround than QTM testing. The ISM provides rapid feedback about emerging products for manufacturers, distributors, government agents, and NGOs and offers a low-cost assessment of a new product's likelihood of passing the full QTM. This screening can also assist companies with ongoing product research and development. The ISM is not designed as an end in itself.
 - 3 or 4 product units are selected by companies themselves and are provided for screening.
 - A sample size of 1 is used for each test; Lighting Global aims to provide results from these tests in approximately 6 weeks from the time that the samples arrive at the test laboratory.
- The **Market Check Method (MCM)** uses test methods that are very similar to the ISM, but samples are obtained from the retail market and the sample size for each test can range from 1 to 6 depending on the objective of the test. This test is used to confirm whether quality-verified products (i.e. products that have met the Lighting Global Quality Standards according to QTM testing) continue to provide the same level of performance over the two-year validity of the test results.

A fourth test method, called the Accelerated Verification Method (AVM) is currently in the process of being developed by Lighting Global. We anticipate that it will be implemented on a pilot-basis for pico-products starting in August 2015.

- The **Accelerated Verification Method (AVM)** is an optional, alternative quality verification pathway to the QTM that is designed to reduce the testing time from about four months to approximately eight to ten weeks. Time savings come from (i) reducing the number of samples required for testing from 18 to 6, (ii) shortening the period for lumen maintenance testing, and (iii) eliminating third-party sampling. These time savings are possible due to the three main elements of the AVM:
 - Eligibility based on the manufacturer's strong history of success with the Lighting Global QA program.
 - Expedited verification entry testing.
 - Strong incentives for compliance through mandatory market check tests and penalties for poor market check test results.

Products must meet the **Quality Standards** to be eligible for services from Lighting Global and the associated regional programs. As of June 2015, the following requirements constitute the core of the Lighting Global Quality Standards for pico-products:

- **Truth-in-advertising:** accurate consumer-facing labeling (e.g., rated run time, light output, battery capacity, PV power)
- **Lumen maintenance:** after 2,000 hours, the product's light output must not drop below 85% of the initial value (alternatively, products may meet this requirement by achieving 95% of the initial light output after 1,000 hours)
- **Battery:** must be durable and adequately protected
- **Health and Safety:** batteries may not contain mercury or cadmium; products are safe
- **Durability and quality:** products are designed and manufactured to avoid early failure
- **Warranty:** products have a consumer-facing warranty with at least one year of coverage
- **Performance Information:** Product packaging reports run time and brightness along with a note about the impact of mobile phone charging

The Quality Standards for SHS kits are similar, but include additional requirements regarding the voltage range of the ports, length of the warranty, information in the user manual, and the ability to replace the batteries.

Testing and verification

The testing and verification activities carried out by Lighting Global are based on the test methods described above. Tests are currently conducted at six independent test laboratories, with additional labs in the process of being added to the network (Table 2).

Table 2. Test labs in Lighting Global network

Test Lab and Location	Approved Tests and Roles
Schatz Energy Research Center (SERC) Arcata, California, USA	*Conduct QTM, ISM, MCM tests *Manage test lab network *Train new labs *Coordinate development of test methods/updates to IEC specification
Lighting Research Center (LRC) Troy, New York, USA	*Conduct QTM, ISM tests *Aid in development of test methods/updates to IEC specification
Fraunhofer Institute of Solar Energy (FISE) Freiburg, Germany	*Conduct QTM, ISM tests *Train new labs *Aid in development of test methods/updates to IEC specification
Shenzhen Academy of Metrology and Quality Inspection (SMQ) Shenzhen, China	*Conduct QTM, ISM tests
University of Nairobi Lighting Laboratory Nairobi, Kenya	*Conduct ISM, MCM tests
The Energy and Resources Institute (TERI) New Delhi, India	*Conduct ISM, MCM tests *Plan to conduct QTM tests
Center for Study and Research on Renewable Energies (CERER) Dakar, Senegal	*Soon will conduct ISM, MCM tests
Ethiopian Conformity Assessment Enterprise (ECAE) Addis Ababa, Ethiopia	*Soon will conduct ISM, MCM tests

Figure 2 illustrates how the QTM and ISM tests are used when a company wishes to test a new product. The manufacturer has the option of either testing their product initially using the lower-cost ISM testing or forgoing

the ISM entirely and testing their product with the full QTM testing. When the AVM testing has been implemented in the near future, eligible companies may also opt to test their products using AVM testing instead of QTM testing. If the QTM or AVM testing shows that the product meets the Quality Standards, the product receives a Standardized Specification Sheet (SSS) and is listed on the Lighting Global website as a quality-verified product.

Regardless of whether the product meets the Quality Standards or not, the manufacturer receives a detailed test report with qualitative and quantitative test results and feedback on how the product could be improved. If the product does not meet the Quality Standards, Lighting Global will work with the manufacturer to resolve the issue. Depending on the nature of the failure, this process may be as simple as changing product labeling and advertising materials. If technical design changes are necessary, depending on the extent of the changes, the manufacturer may be able to resubmit their product for partial re-testing at a lesser cost than full QTM testing. In some cases, depending on the nature of the design changes, full re-testing may be required.

Manufacturers: Program Qualification and Entry

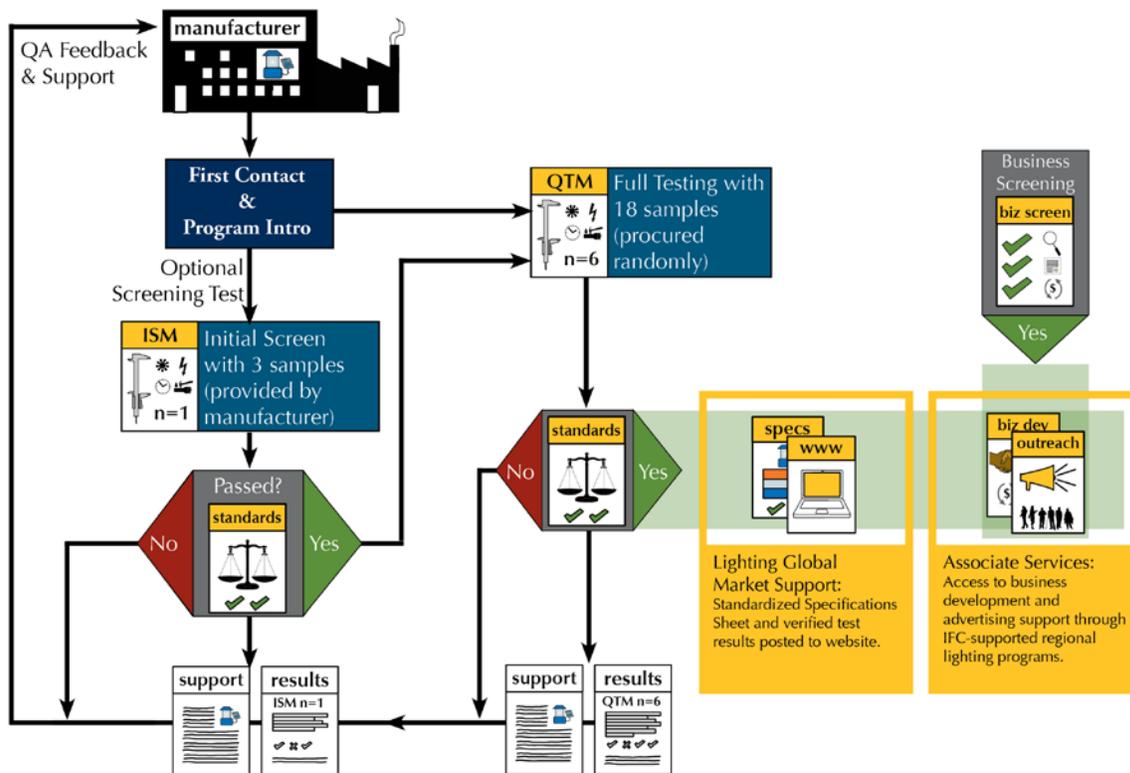


Figure 2. Process for manufacturer engagement and new product testing for pico-products. The same processes will apply for SHS products, though the initial screening would be conducted with 4 samples and the full testing would be conducted with 16 samples for a sample size of four.

Once a manufacturer has a product that meets the Quality Standards, they may begin seek to become a program Associate. Associates are eligible for business development services and outreach campaigns conducted by the regional programs (such as Lighting Africa, Lighting Asia and Lighting Pacific). To become an Associate, the

company must pass a business screening which evaluates the business's potential, integrity, sustainability, as well as its framework for offering warranty protection provided to consumers.¹ Associate services are determined by the regional programs and tailored to the specific needs of local markets.² These services may include:

Marketing

- Associate companies profiles are featured in the Associates Section on the Lighting Global website and products are prominently displayed in the Products Section.
- Associate products may be featured in the scrolling banner on Lighting Global, Lighting Africa and Lighting Asia websites and their “development impact stories” are featured in the newsletter and other program publications such as reports.

Business development services

- Advance access to publications regarding industry trends and market opportunities.
- Guidance on product development based on market, consumer and technical reports.
- Guidance on product lifecycle, recycling and other sustainability issues facing the industry.
- Account management, including regular meetings to discuss business strategy, market developments and emerging business opportunities.
- After-sales service & maintenance training provided for wholesalers and retailers.

Business linkages

- Invitation to trade fairs, exhibitions, conferences, seminars and awards.
- Notification of opportunities for grants, investment and loans.
- Introduction of Associate quality verified products to bulk buyers.
- Business-to-business matchmaking with distributors, and other stakeholders along the supply chain.

Consumer Education

- Invitation to participate in country-based consumer awareness campaigns and regional marketing programs (e.g. road shows, forums, exhibitions etc.) to increase product awareness and sales.
- These campaigns may also include substantial above-the-line media coverage featuring quality-assured products offered in tandem with Associates own marketing efforts.
- Access to negotiated media discounts for advertising related to the consumer education activity.

Market Intelligence

- Reporting on country level product sales performance / market share.
- Access to distribution, marketing and sales reports.
- Country level information on ease of doing business and market potential.

¹ Some elements of the business screening may be required before companies engage with the Lighting Global testing program.

² Lighting Africa, Lighting Asia, and Lighting Pacific country programs may charge fees to Associates in exchange for country or region-specific business support services.

Access to Finance facilitation

- Working capital and credit lines developed for manufacturers, importers and distributors.
- Introduction of the Associate to microfinance institutions to facilitate financing options at a consumer level.
- Introduction of the Associate's distribution partners to local financial institutions.

Figure 3 illustrates how a manufacturer maintains their products' quality-verified status. Periodically, without notice to the manufacturer, each product may undergo market check testing, in which samples are procured from local retail markets and tested using the Market Check Method. The test results are compared to the product's advertising materials and the Lighting Global SSS; any discrepancies result in a re-test with a sample size of six per test to confirm the problem (or a sample size of four in the case of SHS products). The samples for re-testing may be obtained from the retail market or random warehouse sampling at the discretion of the Lighting Global program. For products quality-verified through the proposed AVM testing, market check testing of each product is guaranteed.

If a manufacturer wishes to maintain the quality-verified status of its product after two years, re-testing with randomly selected products is required. If the product under consideration for renewal is identical to the original product (i.e. no significant design changes have been made), then a renewal test with a sample size of two may be used (at least six units of the product are required to complete this testing). However, if significant changes have been made to the design, full QTM testing is required. In any case, if re-testing shows that the product no longer meets the Quality Standards, the product loses its quality-verified status.

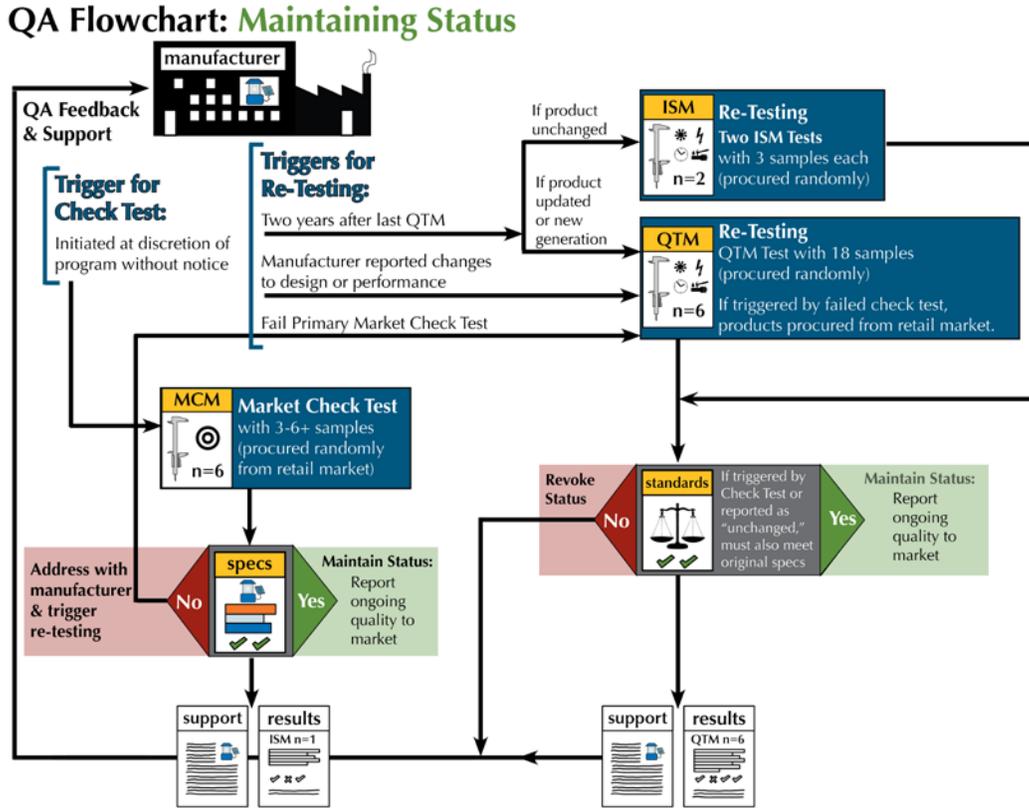


Figure 3. Process for maintaining product status, including Market Check Testing and re-testing due to expiration of results of pico-products. The same framework will apply for SHS products, though the initial screening would be conducted with 4 samples, the market check test could require up to 8 samples, and the full QTM testing would be conducted with 16 samples for a sample size of four.

Communication

The Standardized Specifications Sheet (SSS) is a key tool used to communicate the results of product testing. The SSS summarizes the Quality Test Method (QTM) or Accelerated Verification Method (AVM) results for a product in an easy-to-read format and allows comparisons between products from different manufacturers. Participating manufacturers can use the SSS to provide verified performance data to potential buyers. For distributors, bulk-purchasers, and end-users, the SSS offer a trusted resource for performance verification. As part of the SSS implementation process, Lighting Global has conducted awareness campaigns and informed users and distributors about this means of quality verification.

Only products that have met the Lighting Global Quality Standards and have valid test results receive a SSS. In addition, products that have met the Quality Standards receive a Lighting Global Verification Letter; this document can be used as proof that a product meets the Quality Standards. The SSS and Verification Letters are posted to the Lighting Global website, and users are encouraged to use the website to verify the authenticity of these documents. In addition to the Lighting Global website, the regional programs maintain websites with information about region-specific market interventions to overcome barriers within the off-grid lighting market (e.g., consumer awareness campaigns, workshops for microfinance and finance institutions, and market intelligence reports). Table 3 lists the methods that are used by Lighting Global and the regional programs to communicate with stakeholders.

Table 3. Summary of methods used by Lighting Global and regional programs to communicate with key stakeholders.

Stakeholder	Communications method
Consumers	Advertising campaigns and consumer education conducted by regional programs; SSS and website in cases where consumers have access
Manufacturers	Test reports, SSS, direct outreach by personnel associated with the Lighting Global and regional programs
Distributors, finance and microfinance, retailers, bulk purchasers, NGOs	SSS, website, direct outreach by personnel associated with the Lighting Global and regional programs
Governments (e.g., customs officials)	Verification Letters, SSS, website, direct outreach by personnel associated with the Lighting Global and regional programs

The Future of Global Quality Assurance

The Lighting Global QA framework is designed to balance stability with change. Stable test methods, processes, and thresholds for quality are important for maintaining clarity and relevance, both for those who offer products to the market and the buyers and institutions that need trusted information on quality and performance to drive investment and support decisions. However, as the market (quickly) grows and evolves, the Lighting Global QA framework continues to change as well. The process for updating the framework is based on stakeholder feedback, new information from end-users and supply chain actors, and careful analysis of technology trends in the context of our growing database of test results.

In an assessment that took place in 2013 and 2014, Lighting Global identified several key challenges associated with adapting and scaling the Lighting Global QA program during the coming years as the program continues to transition from a small scale effort that matched the needs of the early market to a larger program that involves increased testing volumes and engagement with greater numbers of people and institutions who rely on timely and trusted information from the program. To date, some measures have been taken to address key challenges that were identified, while other measures are under development.

Challenge 1: Create a faster, lower cost process for product testing without diluting the strength and value of the quality assessment.

Two guiding principles of the Lighting Global QA program are *rigor* and *affordability*. The Lighting Global test methods are designed to incorporate low-cost, yet reliable procedures to seek a balance between these two opposing principles. Despite these considerations, manufacturers continue to rightly cite the duration, expense, and sampling requirements of testing as barriers to successful market entry for new products. Future revisions of the test methods, the expansion of the test lab network, and upcoming changes to the QA framework are all measures currently in progress that are intended to address these concerns.

Drivers:

- **Testing takes too long:** Manufacturers bring products to the market at a fast pace, often with model life cycles of one or two years. The 3-6 month time period for testing can create a barrier for effective distribution of new products, since it can represent 25-50% of the product life cycle. Speeding the time from testing initiation to completion of an assessment, while maintaining the rigor of the program, will better serve both sellers and buyers who want to access the best quality products for their needs that are currently available.
- **Testing is too expensive:** Many companies working in the off-grid lighting market do not have access to substantial capital. Testing fees and associated shipping costs, which are commonly in excess of US\$6,000 per product, can be a significant barrier to bringing products to the market. Lowered testing costs enable emergent businesses to access program resources and may result in lower cost products for consumers. Note that the overall cost of testing has not changed significantly over the past few years, but the level of subsidy provided by IFC and World Bank – initially a large fraction of the cost of testing, has slowly been phased out. As a result, manufacturers now pay the full cost of testing.
- **Requiring 500 products to be available for sampling is burdensome:** To ensure a random sample of products for QTM testing, Lighting Global requires that the 18 products sent for testing be selected from a warehouse with at least 500 units of the same model. Smaller manufacturers or those with alternative manufacturing methods, such as “just-in-time” production, do not typically produce or store 500 units at a time, making this sampling requirement expensive and disruptive to meet. Moreover, even manufacturers with large volume production typically produce in batches, and they generally seek to move the product offsite as soon as possible in order to fulfill orders. If the timing of sample collection is not coordinated precisely, this can hold up orders or lead to delays in the timing of sample collection.

Recent Activities and Next Steps:

- **Development of the Accelerated Verification Method (AVM) [ongoing task]:** As described above, the AVM is an optional, alternative quality verification pathway to the QTM that is designed to reduce the testing time from about four months to approximately eight to ten weeks. Eligibility will be based on the manufacturer’s strong history of success with the Lighting Global QA program, and compliance will be monitored through mandatory market check tests.
- **Enable qualification of ‘families’ of products [complete]:** Some manufacturers offer product lines that consist of a series of similar product models that involve a common set of components. Lighting Global has developed a policy for evaluating these families of products through custom test plans that are designed to minimize the cost to manufacturers while still carrying out a rigorous evaluation of the product line. This approach allows manufacturers to have an entire line of products verified through a single custom test plan, thereby saving time and money.
- **Revisit and revise the test methods [ongoing]:** The Lighting Global test methods as institutionalized in IEC/TS 62257-9-5 are dynamic and meant to be revised regularly based on stakeholder input and market needs. The Lighting Global QA team has identified and incorporated a number of changes to the test methods over the past several years, including several measures aimed at reducing the amount of

time required to complete testing. A revised version of IEC/TS 62257-9-5 is current under review in the IEC process.

- **Develop testing service capacity closer to manufacturers [ongoing]:** The majority of products are produced in China and most sampling occurs at warehouse and factory locations in China. To facilitate lower cost testing and minimize sample shipping costs for manufacturers, Lighting Global is expanding the test lab network to include labs located in China or East Asia, closer to manufacturing centers. Lighting Global recently added a lab in China (SMQ) to the test lab network that is capable of carrying out QTM testing, and we are planning to add more labs in this region. Lighting Global has also worked to develop test lab capacity in India through engagement with a test laboratory at TERI University, as production for some manufacturers is located there.
- **Enable more laboratories to join the Lighting Global test laboratory network [ongoing]:** Expanding the network of test laboratories that are eligible to provide valid test results may reduce testing cost and time for manufacturers by allowing manufacturers to access testing services from a wider array of laboratories. The Lighting Global QA team has developed a new policy to allow manufacturers to procure testing according to the IEC/TS 62257-9-5 from any test laboratory that meets the Lighting Global criteria. Qualifying test laboratories must achieve ISO 17025 accreditation for relevant test methods and meet additional requirements specified in our policy. This policy has been published on the Lighting Global website. The first lab approved under this policy was SMQ in China, and we anticipate adding more labs through this policy over the coming year.
- **Develop a stronger “watchdog” in the market [ongoing]:** During its initial years, the QA program acted as more of a “gatekeeper” to ensure that only quality-verified products were supported by IFC programs. However, with market growth and the introduction of a wider range of test labs, “watchdog” activities, in which products already on the market are monitored for quality, became increasingly important. Lighting Global created a Market Check Method testing framework, and we have been working to increase the frequency of market check testing to ensure adequate monitoring of the market. Lighting Global is also exploring new avenues to develop a sustainable financing mechanism to ensure financial support for these watchdog efforts, such as a market check test fee that would accompany Accelerated Verification Method testing.

Challenge 2: Increase the scope of the Quality Assurance framework to measure system types and features that are prioritized by the market.

The initial focus for Lighting Africa and Lighting Asia activities in the off-grid lighting market was lighting. This was reflected in how the program described products (“modern off-grid lighting products”) and programs (“Lighting” Africa, etc.). As the market has matured (and LED technology along with other superefficient appliances continue to improve), pico-power energy systems now do much more than just provide light. Mobile phone charging, low-power televisions, fans, radios, and other appliances can now be powered by pico-power kits, with the available service depending on the system size. Moreover, small solar home system (SHS) kits that are somewhat larger than those typically considered to be ‘pico-power’ systems have become increasingly affordable. In anticipation of and response to these continued trends, the QA framework is being expanded to cover new energy technology areas.

Drivers for change:

- **Larger kit-based systems with solar module wattages greater than 10 watts are becoming more common and affordable:** Historically the scope of the QA program has covered products with solar modules ranging from 0 to 10 watts. The decreasing cost of solar PV modules, rechargeable batteries, and LEDs have facilitated the development of larger “plug-and-play” SHS kits at a price affordable to many in the off-grid lighting market. These have solar modules between 10 to 100 watts and offer a wide range of services. The test methods included in IEC TS 62257-9-5 (i.e. the methods used by Lighting Global to evaluate pico-solar products) were not appropriate for effectively testing many aspects of these larger kits.
- **Products of all sizes offer auxiliary services:** Based on consumer demand and because more and more energy is available (since LEDs require less and less power), many products provide power for auxiliary loads, the most common of which is mobile phone charging. The test methods included in IEC TS 62257-9-5 do not thoroughly assess these auxiliary uses, and measurements of full-battery and solar run times do not account for the impact of also using the product to charge a mobile phone or power other devices. Beyond additional energy services, some products now include onboard metering and billing technology (“pay-as-you-go” systems). The accuracy of metering and quality of these systems is an important element of the end-user experience.

Recent Activities and Next Steps:

- **Extend scope of product testing to cover larger DC SHS kits [ongoing]:** Lighting Global is working to develop test methods and standards for plug-and-play DC solar home system kits. It is anticipated that these methods will be submitted as a revision of IEC TS 62257-9-6. The effort is being carried out in the spirit of the successful work we completed on IEC TS 62257-9-5, Edition 2.0 (the Technical Specification for off-grid lighting), and it draws from a number of relevant existing methods and standards. Once complete, this will result in a unified framework for preconfigured solar products and kits ranging from 0 to 100 W. The scope of this work includes developing a modified version of the QA framework for larger SHS kits, pilot testing the extended framework, and formally submitting it for approval through the IEC. Lighting Global is employing the same set of QA principles used for pico-power products to develop standards for the SHS market, while continuing to use stakeholder consultations and feedback from the field to inform the process.
- **Build test lab capacity for testing larger SHS kits [ongoing]:** In parallel with developing new test standards, the test labs that will measure system quality and performance need to be identified and prepared. We plan to both expand the network of test labs to include labs that already have capabilities in this area and build the capacity of labs that thus far have focused on pico-power lighting systems.
- **Measure and report auxiliary power capabilities for pico-power products [ongoing]:** The work we complete in support of SHS testing will result in better methods for estimating the level of service available to users who plug their own appliances (like mobile phones) into the full range of pico-power systems. One focus of this effort will be incorporating measurements of auxiliary power capabilities in all products (not just SHS). A key challenge to this effort is establishing an effective and clear way of communicating the capabilities in light of the wide diversity of power consumption for mobile devices and the impact of user behavior on performance.

Challenge 3: Improve communication to buyers

Our program's initial efforts with regard to communication of information about product quality have focused primarily on reaching upstream supply chain actors (e.g. product importers and distributors), bulk purchase buyers, financial institutions, investors, and government officials. We chose this approach in part because of the important role that these actors play in the market and in part because it is relatively easier and less costly to reach these people and organizations than it is to reach retail vendors and end consumers. While this approach has contributed to the success of the Lighting Global Quality Assurance program, the effectiveness of the program can be enhanced through selected, cost-effective measures aimed at making information about product quality more widely available to "downstream" actors such as retail vendors and end consumers.

Drivers:

- **On-the-package information about product performance is not reported uniformly:** Buyers of off-grid lighting products are best positioned to make good purchasing decisions when they have access to accurate and reliable information about product quality and performance. The Lighting Global Quality Standards help ensure that qualifying products meet basic minimum quality requirements and that manufacturers adhere to truth-in-advertising. However, it is additionally important for end-consumers to be able to compare products with regard to key performance metrics when they are considering a purchase. On-the-package reporting requirements that ensure that all products that meet the Lighting Global Quality Standards report key metrics in a consistent way can help achieve this goal.
- **The Lighting Global website remains inaccessible for most retail vendors and end-users:** The Lighting Global website is the program's primary tool for communicating information about product quality to supply chain buyers and other key stakeholders. However, important stakeholders, such as retail vendors of off-grid lighting products and end consumers, do not have reliable access to this information due to lack of conventional internet connectivity. Lighting Global research indicates that an increasing number of retail vendors and end consumers are accessing the internet through mobile devices such as smart phones and feature phones. Designing website content that is compatible with these mobile devices can therefore help expand our program's ability to reach these important stakeholders.
- **Program lacks "on-the-package" quality seal:** While many manufacturers, distributors and standards/customs agencies understand the value of the Lighting Global SSS and Verification Letter, the program currently lacks an "on-the-package" mechanism to effectively communicate quality-verified status and/or performance to buyers across the supply chain. While the Lighting Africa, Lighting Asia, and Lighting Pacific programs are using (or are planning to use) consumer awareness campaigns to communicate quality in some countries and regions, this approach is limited geographically and is unlikely to continue after current program funding expires. A quality seal or label, if deployed effectively and with sufficient resources, could help buyers across the supply chain and manufacturers of high quality products alike by clearly signaling product quality to the market. An effective quality seal could also help generate demand for a long-term quality assurance program, provided that it delivers value to manufacturers of good quality products at a reasonable cost.

Recent Activities and Next Steps:

- **Implementation of on-the-package reporting requirements [complete]:** Lighting Global recently implemented a policy on performance reporting requirements ensuring that all quality-verified products going forward will display key performance information on their packaging. The reporting requirements include the metrics that consumers have indicated are the most important to them, such as product light output, run time, and warranty terms. While manufacturers are required to report particular metrics, they have flexibility with regard to the format for presenting the information. The policy was developed in close collaboration with the Global Off-Grid Lighting Association and is available on the Lighting Global website.
- **Development of online information about product quality assurance that is accessible through mobile devices [ongoing]:** Lighting Global is in the process of developing web content related to product quality assurance that is compatible with mobile devices such as smart phones and feature phones. We expect to make this content available over the coming year. The goal is to enhance our program's ability to deliver information about product quality to key stakeholders who access the internet primarily through mobile devices.
- **Analysis related to the development of an “on-the-package” quality seal [ongoing]:** Lighting Global, Lighting Africa, and the U.S. Department of Energy conducted a preliminary analysis of communication strategies to effectively deliver information about quality to buyers across the supply chain. The analysis was led by Navigant Consulting in close collaboration with the Lighting Global QA team. This analysis indicated that a basic “business to business” (B2B) quality seal could be an effective tool for delivering information about quality at a reasonable cost. A consumer-facing quality label might also be considered, but the marketing costs required to effectively raise awareness about the label are substantial. Moreover, prior experience with quality labels indicates that they are most effective when the branding and communication materials are tailored to a particular country or region (i.e. a uniform, global quality label may not be a viable and effective strategy). Lighting Global is committed to improving its ability to communicate quality across the supply chain. Analysis of this topic is ongoing, and a decision about next steps has not yet been finalized. Given that effective implementation of a quality seal is a substantial task, it is unlikely that Lighting Global will initiate this task before a sustainable, long-term solution has been identified for the quality assurance program.

Challenge 4: Long-term sustainability of QA program

Funding for the Lighting Global program, including the quality assurance component, is expected to last for approximately two more years (until June 2017). The need for quality assurance in the off-grid lighting and energy systems market will continue into the future, and it is therefore important to establish a financially viable, long-term framework that will allow for continuation of the quality assurance effort.

Drivers:

- **Long-term sustainability of the QA program:** The QA program has been supported by the IFC and World Bank through the Lighting Africa, Lighting Asia and Lighting Pacific programs, and it will continue to be supported by the IFC and World Bank in the context of the Lighting Global program for the next two years. Other organizations such as the U.S. Department of Energy and GIZ have also

provided funding for specific quality assurance related activities. However, the market need for trusted and reliable information about product quality will continue well beyond current commitments from these institutions. During the next two years, Lighting Global must therefore determine a strategy and business model that will help ensure that effective quality assurance services are maintained on a sustainable basis beyond the end of the program.

Recent Activities and Next Steps:

- **Development of a long term quality assurance strategy [ongoing]:** Lighting Global has been working to develop a long term strategy to institutionalize the quality assurance effort so that it can be sustained after current program support from IFC and World Bank ends in about two years. This effort has involved support and collaboration with partners such as the U.S. Department of Energy, Lawrence Berkeley National Laboratory, Navigant Consulting, and the International Electrotechnical Commission. It has also involved engagement with key industry stakeholders such as the Global Off-Grid Lighting Association (GOGLA).
 - One of our strategic partners, [Global LEAP](#), has support efforts to develop a long term quality assurance strategy for the off-grid solar sector by funding a study carried out by Navigant Consulting titled, “*Analysis of the Potential Future of the Lighting Global Quality Assurance Program.*” The work involved close coordination between Lighting Global, Navigant Consulting, and the Global Off-Grid Lighting Association (GOGLA). The document should be available for download soon on the Global LEAP website.
 - Analysis to date indicates a need to establish a trusted, reliable, and independent certification body that builds on the experience of the existing Lighting Global program. While work is ongoing, Lighting Global anticipates that a proposed preliminary framework and terms of reference for such an organization or consortium of organizations will be released in the near future.
 - Key steps that represent progress toward laying the foundation for a long term quality assurance framework have already been taken. These include:
 - Institutionalization of the quality assurance framework through the IEC in the form of IEC TS 62257-9-5, Edition 2.0.
 - Expanding and commercializing the testing framework, thereby increasing the options for manufacturers that seek testing services for their products.
 - Working to establish a strong working relationship with GOGLA in order to enable GOGLA to serve as a key conduit for industry input on matters related to quality assurance.
- Additional important steps will be taken over the coming months and years.

Conclusion

Lighting Global is committed to the continued development of a practical, dependable, and sustainable quality assurance framework for off-grid lighting and energy systems. This document briefly describes the existing

quality assurance program and identifies areas for future change as the program works to adapt to evolving market conditions. In some cases the measures described in this document will take time to develop and implement, but with patience and persistence we are confident that we can succeed. We value input from key stakeholders ranging from product manufacturers to end-users, and we look forward to continued engagement as we work to fulfill our mission of quality-assured clean energy systems for off-grid applications.