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Product Quality Assurance for Off-Grid Lighting in Africa

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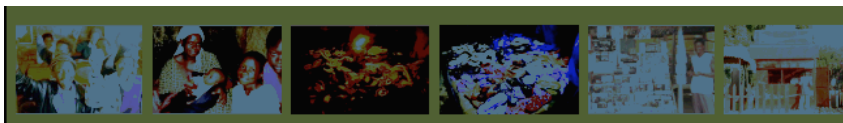
**Conference Proceedings from the Lighting Africa Product Quality
Assurance Workshop**

Airlie Conference Center, Airlie VA, October 14-16, 2007

**Workshop Sponsors
International Finance Corporation (IFC)
World Bank (WB)**



THE WORLD BANK



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Lead author: Lindsay Madeira, International Finance Corporation

Editorial Support: Kathryn M. Conway, Conway & Silver, Energy Associates LLC

ABBREVIATIONS

CDM	Clean Development Mechanism
CFL	compact fluorescent light
CO	carbon monoxide
CO₂	carbon dioxide
DC	direct current
ELI	Efficient Lighting Initiative
ELI QCI	Efficient Lighting Initiative Quality Certification Institute
EPA	United States Environmental Protection Agency
ESMAP	Energy Sector Management Assistance Program (of the World Bank)
GEF	Global Environmental Facility
IEC	International Electrotechnical Commission
IFC	International Finance Corporation
kWh	kilowatt hour
LED	light-emitting diode
NiMh	nickel metal hydride
NGO	non-governmental organization
NO₂	nitrogen dioxide
ppm	parts per million
PV	photovoltaic
PV GAP	Global Approval Program for Photovoltaics
SHS	solar home system
SO₂	Sulfur Dioxide
USD	United States Dollars
US EPA	United States Environmental Protection Agency
VOC	volatile organic compound
W	watt
WBG	World Bank Group

DISCLAIMER

Every attempt has been made to accurately convey a summary of the discussions held at this workshop. Readers should note that the suggestions made in this document are for consideration only and do not constitute a formal recommendation to the sponsors or other parties.

EXECUTIVE SUMMARY

Background

Lighting Africa is a World Bank Group initiative aimed at providing up to 250 million people in sub-Saharan Africa with access to non-fossil fuel based, low cost, safe, and reliable lighting products with associated basic energy services by the year 2030. Linking lighting and development, modern lighting can:

- Extend the working day for small and medium enterprises thus expanding production, enriching income opportunities, improving working conditions, and increasing customers.
- Enhance safety and security via outdoor lighting for personal, business, and community activities.
- Create conditions to attract teachers, retain students, expand time for student reading and studying, and improve grades and school retention rates.
- Provide opportunities for adult literacy and higher education programs.
- Improve health services delivery and thus reduce productivity loss due to illnesses

Currently, 1.6 billion people worldwide are without access to electricity. The problem is most acute in sub-Saharan Africa where over 500 million people presently lack modern energy, with rural electricity access rates as low as two percent. Among the poorest of the poor, lighting is often the most expensive item among their energy uses, typically accounting for 10-15% of total household income. While consuming a large share of scarce income, fuel based lighting provides little in return.

New advancements in lighting technology, such as compact fluorescent lights (CFLs) and light emitting diodes (LEDs), promise clean, portable, durable, lower cost, and higher quality lighting. The challenge is to make these products accessible to the half billion "lighting poor" in Africa. With expenditures on fuel based lighting estimated at US\$38 billion annually, the potential exists to engage the international lighting industry in this new market area, while serving consumers, bolstering local commerce, creating jobs, enhancing incomes, cleaning the air, and improving health, safety, and quality of life.

Workshop

Although the emergence of markets for high efficiency off-grid lighting technologies holds promise, realizing the potential of this opportunity on a long-term, sustainable basis requires careful attention to issues of product quality, consumer protection, and the potential for significant "market spoiling," in anticipation of increases of sales of low cost, low performance off-grid lighting products. The goal of the Lighting Africa quality assurance workshop was to articulate strategies to mitigate the dangers of market spoiling and to explore ways to protect consumers from misleading advertising for sales of inferior, off-grid lighting products in the context of Lighting Africa's overarching objective to support the industry in developing a robust off-grid lighting market in Africa.

Outcomes

The workshop resulted in the identification of two strategic approaches for meeting Lighting Africa quality assurance programmatic needs.

The first strategy is intended to meet a short-term programmatic need for quality associated with requests for lighting products by bulk procurement agents, such as in a World Bank-financed

project. The development of procurement specifications and test procedures that could be used in a quality/usability screening method in order to provide guidance for forthcoming large volume purchases emerged as the best solution to meet this need. Such approaches are used in World Bank-financed solar home systems (SHSs) projects in Bangladesh, Sri Lanka, and China, among others. However, unlike the SHSs which have multiple balance-of-system (BOS) components warranting the need for an array of specifications for individual components, stand alone lighting systems require specifications that are amenable to individual light points. To test this approach, Lighting Africa elected to use the technical specifications issued by the Photovoltaic Global Approval Program for solar lanterns that use CFL bulbs (PVRs11A) as the basis of qualifying such products.¹ A contract has been competitively awarded to the Global Approval Program for Photovoltaics (PV GAP) under the Lighting Africa Program to select and test ten solar lantern product models. Lantern selection will be determined based on a number of criteria, among them, the ability to provide a daily duty cycle of at least 3 hours of light, the number of days of autonomy of battery, the volume of sales (especially in Africa), and whether or not the manufacturing facility is ISO 9000 certified. Those that are confirmed as meeting the specifications may be eligible to receive a PVGAP quality seal. The work is being carried out in partnership with the Photovoltaic and Wind Quality Test Center in Beijing, China and TÜV Rhineland in Köln, Germany.

As off-grid LED-based stand-alone lighting products is in a nascent stage of development compared to CFL-based lanterns, Lighting Africa will support the development of a “Quality Screening” approach to selecting LED lighting, in order not to delay consumers benefiting from such advances. The screening methodology could be used by procurement agencies to qualify LED lighting products for bulk or programmatic procurements. The main elements of this work comprises of developing a procurement specification and test procedure for undertaking a “quick” quality/usability screening to be used for procuring LED lights and to test up to 30 LED-based lights to screen products that meet the requirement.

The second strategy is intended to meet a longer-term need associated with creating a self-sustaining product quality assurance program that will effectively protect the African consumer, prevent significant market spoiling, adapt with expected technological advancements over the long-term – in other words, give consumers the ability to detect quality products and the information needed to find products that meet their specific needs from among the myriad of lighting products that become available commercially. Workshop discussions and the discussions evolving from the workshop led the Lighting Africa team to opt for an approach similar to that of the “Fair Trade” model, involving the creation of a set of voluntary criteria which companies can elect to subscribe to in order to receive a product evaluation/certification. This solution was proposed as it has the widest capacity to incorporate the largest number of recommendations from the workshop sessions. This code of conduct will be made available for companies to comment on later in 2008.

These workshop proceedings provide an overview of workshop discussions and a summary of the key points identified around various workshop topic areas, contributing to the two strategy approach Lighting Africa will take as it moves forward with developing its quality assurance program.

¹ PVGAP, “Portable Solar Photovoltaic Lanterns: Performance and Certification Specification, and Type Approval,” ESMAP Technical Paper No. 078, August 2005.
<http://www.esmap.org/filez/pubs/07805WholeReportFinal3106.pdf>

BACKGROUND

The Problem

An estimated one-third of the world's population, nearly 1.6 billion people, lack access to modern energy services including electricity for lighting², numbers that are only expected to decrease slightly to 1.4 billion by 2030 under business-as-usual scenarios. In sub-Saharan Africa this problem is particularly acute, with up to 90% of the rural population and 74% of the total population living outside of grid connectivity (Table 1 and 2).

Table 1: Electricity Access in 2005: Regional Aggregates

	Population (million)	Urban Population (million)	Population without electricity (million)	Population with Electricity (million)	Electrification Rate (%)	Urban electrification rate (%)	Rural electrification rate (%)
Africa	891	343	554	337	37.8	67.9	19.0
North Africa	153	82	7	146	95.5	98.7	91.8
Sub-Saharan Africa	738	261	547	191	25.9	58.3	8.0
Developing Asia	3 418	1 063	930	2448	72.8	86.4	65.1
China and East Asia	1 951	772	224	1728	88.5	04.9	84.0
South Asia	1 467	291	706	760	51.8	69.7	44.7
Latin America	449	338	45	404	90.0	98.0	65.6
Middle East	186	121	41	145	78.1	86.7	61.8
Developing countries	4 943	1 866	1 569	3 374	68.3	85.2	56.4
Transition economies and OECD	1 510	1 090	8	1 501	99.5	100.0	98.1
World	6 452	2 956	1 577	4 875	75.6	90.4	61.7

Source: IEA, World Energy Outlook, 2006

Lacking electricity, this population relies largely on traditional forms of energy—biomass, charcoal, candles or fuel-based sources such as kerosene and paraffin—to meet basic service needs. These sources are environmentally, socially, and economically problematic because they create light inefficiently, often at high expense to the consumer. Fuel-based lighting causes indoor and outdoor pollution and degrades the environment; it also limits productivity and can impair human health. In Africa, the majority of those who do not have electricity use fuel, primarily kerosene, to meet their lighting needs.

² UNDP. *World Energy Assessment: Energy and the Challenge of Sustainability*, UNDP, *World Energy Assessment: Overview 2004 Update: Overview*.

Table 2: Electricity Access in African Countries

	Electrification Rate (%)	Population without electricity (million)	Population with electricity (million)	Sources
Angola	15.0	13.5	2.4	Empresa Nacional de Electricidade de Angola (2005), SADC (2005)
Benin	22.0	6.5	1.8	ESMAP, Societe Beninoise d'Electricite et d'Eau (2004)
Botswana	38.5	1.1	0.7	Botswana Power Corporation Annual Report (2005), SADC (2005)
Burkina Faso	7.0	12.4	0.9	OECD (2003), ESMAP, Mbendi.co.za
Cameroon	47.0	8.7	7.7	ILO/International Institute for Labour Studies (2004), <i>Cameroon Tribune</i> (2003)
Congo	19.5	3.2	0.8	ADIAC
Dem. Rep. Of Congo	5.8	53.8	3.3	GNESD (2004), SADC (2005)
Core d'Ivoire	50.0	9.1	9.1	UNDP (2003)
Eritrea	20.2	3.5	0.9	Risoe – Energy for Development (2003)
Ethiopia	15	60.8	10.7	EEPCo (2003), US Department of Commerce (2002), CNHDE (2004), Addis Ababa University
Gabon	47.9	0.7	0.7	ESMAP (2000)
Ghana	49.2	11.3	10.9	Energy Foundation of Ghana, Volta River Authority (2004)
Kenya	14.0	29.4	4.8	Kenya Power and Lighting Company (2004)
Lesotho	11.0	1.9	0.2	GNESD (2004)
Madagascar	15.0	15.2	2.7	GNESD (2004), jirama (2004)
Malawi	7.0	11.8	0.9	AFREPREN (2001), SADC (2004)
Mauritius	93.6	0.1	1.2	AFREPREN (2002), SADC (2004)
Mozambique	6.3	18.6	1.3	SADC (2004)
Namibia	34.0	1.4	0.7	SADC (2005)
Nigeria	46.0	71.1	60.5	ESMAP (2005), Ministry of Power (2006), BPE (2006)
Senegal	33.0	78.8	3.8	GNESD (2004), Commission de Regulation du Secteur de l'Electricite du Senegal (2004)
South Africa	70.0	14.0	32.6	SADC (2005)
Sudan	30.0	25.4	10.9	SADC (2005), Engineers Without Borders (2004)
Tanzania	11.0	34.2	4.2	SADC (2005), Helio International
Togo	17.0	5.1	1.0	ESMAP (1008)
Uganda	8.9	24.6	2.4	AFREPREN (2001), Ugandan National Administration (2005)
Zambia	19.0	9.5	2.2	AFREPREN (2001), DHS (2001/2002)
Zimbabwe	34.0	8.7	4.5	SADC (2005), AFREPREN
Other Africa	7.6	83.6	6.9	IEA estimate
Sub-Saharan Africa	25.9	546.9	190.7	
Algeria	98.1	0.6	32.3	Ministry of Energy and Mining, Sonelgaz (2004), OME (2006)
Egypt	98.0	1.5	72.4	US Department of Commerce (2004), OME (2006)
Libya	97.0	0.2	5.7	OME (2006)
Morocco	85.1	4.5	25.8	Ministry of Energy and Mines, Office National de l'Electricite (<i>Annual Report 2004</i>)
Tunisia	98.9	0.1	10.0	ESI Africa, Insitut National de la Statistique, OME (2006)
North Africa	95.5	6.9	146.1	
Africa	37.8	553.7	336.8	

Source: Compilation reproduced from IEA, World Energy Outlook, 2006

Fuel-based lighting has significant negative implications for the environment, due to indoor air pollution it creates as well as contributing to global CO₂ emissions. For example, the average concentration of nitric acid released from burning a kerosene lamp is 0.66 parts per million

ppm).³ However, after reacting with oxygen in the environment to form nitrogen dioxide (NO₂), these levels skyrocket, often reaching 3.33 ppm, more than 62 times the United States Environmental Protection Agency's (EPA) allowable maximum concentration of 0.053 ppm.⁴ Sulfur dioxide (SO₂) emissions are roughly 566 times the EPA's maximum allowable concentration level of 0.03 ppm and hazardous volatile organic compounds (VOCs) represented 0.26 % of the gases released. Carbon monoxide (CO) emissions, which have been found to reduce the amount of oxygen delivered to the human bodies' organs resulting in dizziness, vision problems, fatigue, memory loss, and diminished dexterity and concentration at concentrations as low as 200 ppm, reigned in at upwards of 3 times this figure, at 677.33 ppm.⁵ With respect to carbon dioxide (CO₂) emissions, according to a recent study undertaken by Mills (2005), a kerosene lantern used for 4 hours per day is estimated to release more than 100 kg of carbon dioxide into the air over the course of a year.⁶ This is equivalent to the amount of carbon released from generating 100 kilowatt hours (kWhs) of electricity from a coal-fired power plant or burning a 70 watt lamp for 4 hours per day for 1 year.⁷

Fuel-based lighting also poses a significant economic burden to society, impeding its ability to progress. It is costly, inefficient, and provides poor quality light, creating a substantial burden for consumers who often spend 10-15% of their annual cash income on kerosene. Adding the costs to buy and maintain luminaires (lighting fixtures) and to purchase fuel for lighting, non-electrified households and micro-businesses may spend upwards of 20-30% of their annual earnings on poor quality lighting. Today, this problem is even more severe, in light of the surge in crude oil prices, currently exceeding \$108 per barrel. Users who lack access to reliable, good quality light live in a state of energy poverty—a state linked to economic poverty, largely as a result of the absence of opportunities that sufficient, good quality lighting provides. Thus, access to reliable, affordable light is critical to poverty reduction. Light yields significant economic and social benefits such as extending the operating hours of businesses that otherwise close at dark, increasing educational activities, increasing employment and income-generating activities, improving quality of life, family welfare and human health. Improved air quality resulting from increased access to modern lighting would disproportionately benefit those who are most vulnerable to the negative impacts associated with traditional forms of energy- those who spend the greatest amount of time indoors, namely the elderly, ill, women and children.

Compounding the problem of energy poverty is the growing realization that the present technologies employed to deliver light are limited in their capacity to effectively reach certain market segments, especially the rural poor, with affordable solutions. Utilities, for example, frequently regard grid extension to dispersed rural communities, many of which reside in areas of rugged terrain in low population densities, as an economic burden. Similarly, Solar Home Systems (SHSs), while offering a superior technological option to provide a higher levels of energy services in many off-grid applications, come with first cost barriers that often limit their sale to those in higher income brackets or who have access to finance. Hence, enriching the menu of technological options for off-grid light provision that could *complement* and diversify the current portfolio would fill a niche that is presently lacking in technological options, in turn, making affordable, sustainable, lighting available to the millions of people who have not yet been able to realize modern lighting options.

³ R; Doluweera Peon, G. *et al*, Solid State Lighting for the Developing World--the Only Solution. *Optics & Photonics 2005, Proceedings of SPIE* (San Diego: Light Up the World 2005).

⁴ U.S. Environmental Protection Agency. See: <http://www.epa.gov>, (February, 2005).

⁵ Ibid.

⁶ E.Mills. "The Specter of Fuel Based Light." *Science*, 27 May 2005:308:1263-1264.

⁷ Ibid.

The Opportunity

Technical Advances

Due to rapid efficiency gains, high light output, low power requirements, design flexibility and affordability, modern lighting technologies such as compact fluorescent lights (CFLs) and light emitting diodes (LEDs) hold the promise of providing superior alternatives to fuel-based and other traditional sources of lighting. LEDs have minimal power requirements, are durable, easily controlled, and inherently direct current, so they show particular promise for use as a standalone lighting system, especially for remote, non-electrified areas of developing countries. LEDs are still increasing in efficiency and quality, a trend that industry intends to accelerate, making LED lighting systems more feasible and affordable for a wide range of applications. The efficiency of white LEDs are now exceeding that of CFLs.

Lighting Industry Interest in New Growth Market

Anecdotal evidence suggests that a substantial market opportunity may exist both on the supply and demand side of the off-grid lighting market. On the supply side there is significant interest from international electric lighting industry players to explore new growth opportunities. In general, the lighting market is largely static; many types of lamps are commodities, the market has reached maturity, and manufacturers find themselves competing for market share, often operating with limited profit margins (as low as two percent for incandescent and linear fluorescent lamps)⁸. On the demand side, significant evidence points to a potentially enormous market that is willing to pay for off-grid lighting. While the 1.6 billion people worldwide who lack access to electricity and largely live in extreme poverty are often not considered part of formal lighting markets, they make up as much as 17% of the global lighting market. They spend the equivalent of US\$38 billion annually on fuel-based lighting. In Ghana and Kenya alone, US\$1.4 billion is spent by only two segments of the population: non-electrified households and small businesses. Hence, the opportunity to tap into a new market with as many as 50 million new consumers in Ghana and Kenya and millions more across Africa and around world is extremely attractive to many players in the electrical, lighting, and consumer appliance industries.

Strategic Synergy with World Bank Group (WBG) Mission and Priorities

Arising from the 2005 meeting in Gleneagles, Scotland, the G8 and the +5 countries (Brazil, China, India, Mexico, and South Africa) agreed on the Gleneagles Plan of Action on Climate Change, Clean Energy, and Sustainable Development. In response to this call to action, the WBG developed the Clean Energy Investment Framework in consultation with other international financial institutions. The Clean Energy Investment Framework is a detailed plan of action comprised of three independent yet interrelated pillars: (i) *Energy for Development and Energy Access for the Poor*- meeting the energy needs of developing countries and widening access to energy services for their citizens in an environmentally responsible way (ii) *Toward a Low Carbon Economy*- reducing greenhouse gas emissions and speeding the transition to a low-carbon economy (iii) *Adaptation to Climate Change and Variability*- helping developing countries adapt to climate risks.

⁸ Within ten years, for example, compact fluorescent lamps became commodities. Retail prices dropped from as high as \$23 (in Argentina in 1999 at the beginning of the IFC/GEF ELI program) in specific markets to a commodity price of \$0.50 each for high quality products purchased wholesale in the (Global Environmental Facility) GEF-funded Rwanda lighting program in 2007.

The Effort

The WBG launched “Lighting Africa” to respond to the urgent need to increase energy access by providing modern lighting (pillar i) recognizing that even with the best efforts of expanding electrification programs, about 250 million in Africa alone will be without grid-based electricity in 2030. Lighting Africa sees opportunities in:

- Recent technological developments in lighting and their applicability to the developing world;
- Significant industry interest in developing a potentially huge market for off-grid lighting; and,
- Strategic synergy with overall WBG mission and priorities.

Aimed at providing up to 250 million people in sub-Saharan Africa with access to low cost, safe, and reliable lighting products with associated basic energy services by the year 2030, Lighting Africa was launched in September 2007 with significant donor support. Jointly managed by the World Bank and the International Finance Corporation (IFC), Lighting Africa addresses lighting needs of rural, urban, and peri-urban users—predominantly low income households and micro-businesses by supporting the rapid scale-up and delivery of affordable, non-fossil fuel lighting, targeting opportunities for dramatic cost reductions.

The Approach

As part of this broader WBG effort to increase energy efficiency and access, Lighting Africa is a market-based initiative designed to help entrepreneurs across the world innovate and deliver new lighting products that will provide alternatives to the status quo.

The approach is grounded in extensive consultation with the lighting industry. During the project concept stages, the project team spent 2 years engaging a range of players from the industry, both globally and locally in the target markets. Through consultation with more than 100 lighting companies and over 90 stakeholders, the program was developed. As a market accelerator, Lighting Africa seeks to reduce key market barriers by working with public and private sector stakeholders across a variety of sectors to reduce transaction costs, mitigate market risks, improve quality and promote commercial responsibility.

Lighting Africa achieves this by:

- Catalyzing the private sector, including strengthening ties between the international lighting industry and local suppliers and service providers to profitably manufacture, market, and distribute significantly lower cost products.
- Facilitating consumer access to a range of affordable, reliable and high quality lighting products and services.
- Improving market conditions for the scale-up of modern lighting products, to include eliminating existing technical, financial, policy, information, and institutional barriers.
- Mobilizing the international community—governments, private sector, international organizations and non-governmental organizations (NGOs) — to aggressively promote penetration of modern lighting services for the poor in Africa.

Lighting Africa has a multi-pronged strategy to address both demand-side and supply-side constraints in market development. Lighting Africa will:

- Support market research to better understand consumer demand behavior and preferences, global lighting industry interests and priorities, and local supplier, marketing, and distribution channels.
- Strengthen ties between the global lighting industry and local service providers, to design, develop, and deliver rugged low cost lighting products by sponsoring of a

Development Marketplace Competition, facilitating of business-to-business linkages, and strengthening small and medium enterprises.⁹

- Finance facilitation to increase access to affordable financing for suppliers and end-users, reduce investor risks, mobilize local financial institutions (including micro-finance), offer WBG financing under the Africa Energy Access Scale Up Plan, and creatively apply Clean Development Mechanism (CDM) strategies to bring down product costs for consumers.
- Develop a quality assurance effort, to improve product quality and increase consumer awareness and confidence in new-to-market lighting products and services.
- Aggregate market demand, through policy support, bulk market purchasing, risk sharing, and linkages to cross sector programs (such as health, education and water).
- Stimulate knowledge sharing and capacity building, to include a business-to-business web portal; training and train-the-trainers programs; public-private partnerships; institutional strengthening; and development of new business models, toolkits, for use by governments, donors, and the private sector.

Lighting Africa Product Quality Assurance Program Rationale and Objectives

Lighting Africa planning discussions identified the development of a quality assurance effort as a critical program objective. Lighting Africa will formulate a quality assurance program that takes advantage of recent technological advances and expected technological development to help prevent significant market spoilage in this emergent market and address the following concerns:

Consumer needs, preferences and expectations

Products may fail in the market either because their design does not meet consumer needs and preferences or because the technology does not perform as users expect. Although performance specifications and testing procedures for modern grid-connected lighting systems are widely used, adequate performance specifications for off-grid lighting products have yet to be widely used – beyond those used in solar home systems projects, and developed by PVGAP and others.¹⁰ This poses a significant problem for the African consumer, who will be unprepared to distinguish product quality on the vendor shelf, and who will be most negatively impacted by ill performing products; early product failure will hurt the pockets of optimistic consumers, contributing to significant buyer dissatisfaction and a disincentive to purchase again.

On behalf of the populations that WBG intends to address, the Lighting Africa quality assurance effort will identify high-performance products and tackle these issues:

- High cost of products. Price points that are not aligned with consumer purchasing power.
- Lack of product information necessary for consumers to make informed product selections. Consumers who are uninformed or misinformed about product performance and task applicability would benefit from access to simple metrics to easily select the type of lamp that is most appropriate for their lighting needs.
- Improved consumer capacity to compare performance among competing products and make informed purchase decisions will help the market mature.
- Increased consumer awareness and confidence in the purchase and application of LED lighting products for widespread acceptance and market scale up.

⁹ See <http://www.worldbank.org/developmentmarketplace> for details.

¹⁰ See <http://www.worldbank.org/retoolkit>, sublink Project Tools > Technical Standards and Specifications, or <http://www.pvgap.org>

- Increased consumer and retailer knowledge about illumination levels, useful life, durability, robustness, costs and maintenance to help consumers articulate their own needs and help retailers source products that can meet those needs.
- Inadequate available product range. The range of available products is presently not diverse enough to meet consumer demand. Improved product designs for LED lighting products would ensure delivery of the services expected by consumers.

THE WORKSHOP

Goals and Focus

The Lighting Africa quality assurance effort has three goals: (1) to support industry/manufacturers in developing a sustainable market for their products (for example, by creating a level playing field, providing necessary metrics and benchmarks for product design, and fostering market competition); (2) to protect the buyer from purchasing inferior products or those that do not meet their expectations. This is especially important for low-income buyers who cannot afford to incur substantial losses if products fail; and, (3) to avoid reputational risks from supporting programs that might introduce poorly performing or unsafe products that have the potential to cause long-term market spoiling.

The Lighting Africa Program invited a diverse group of experts discuss quality assurance approaches, evaluate their fit with Lighting Africa objectives, and begin to articulate the next steps in devising quality assurance mechanisms. Questions to be resolved included:

- Why does Lighting Africa need quality assurance?
- What lessons have we learned from previous attempts to develop quality assurance for off-grid applications in developing countries that we could use to inform Lighting Africa's quality assurance strategy?
- What approaches exist for developing quality assurance for off-grid lighting products?
- Which approaches would best serve the objectives of Lighting Africa?
- What are the details of implementing the quality assurance approaches?

All approaches identified during the workshop were evaluated according to five Lighting Africa quality assurance objectives:

- Prevent market spoiling.
- Complement consumer education efforts.
- Provide a level playing field for competition.
- Protect consumers by providing them with accurate product information, appropriate pricing, and relevant design attributes.
- Provide a quality platform for bulk procurement agents.

Additionally, Lighting Africa should comply with the following basic principles:

- Enable, not restrict the market and innovation
- Let consumers choose the performance criteria or service levels they need.
- Work for a range of products, technologies and market segments.
- Be practical and enforceable.
- Be sustainable and replicable.

Workshop Presentations and Group Discussions

The workshop consisted of 2½ days of presentations, group brainstorming and breakout sessions. Each session was led by a moderator and started off with presentations followed by a group exercise. See Annex 2 for the full workshop agenda and Annex 3 for the list of participants.

OPENING EVENING

- Introductions
- Discussion: Using Off-Grid Lighting To See

DAY ONE

- Presentation: Product Quality Assurance Rationale for Lighting Africa
- Presentation: Varying Approaches and Perspectives in Developing Quality Assurance for Off-grid Lighting
- Case Study: Efficient Lighting Initiative (ELI) Quality Certification Institute
- Case Study: Developing Specifications for Solar Lanterns in Developing Country
- Case Study: Experiences with Developing Quality Assurance for PV in Africa
- Presentation: Nomenclature
- Summary: Independent Testing and Labeling, Two Models
- Summary: Voluntary, Opt-In Programs

DAY TWO

- Summary: Elements of a Quality Assurance Process for Short-Term Procurement
- Summary: Elements of a Long-Term Quality Assurance Framework

The workshop had three deliverables: Compiled presentations; workshop proceedings; and, summary of approach and projected actions. The presentations are summarized below and can be reviewed in their entirety in the CD included in the back of these proceedings.

Discussion: Using Off-Grid Lighting to See (*A. Jacobson and K. Conway*)

Participants enjoyed a hands-on activity that simulated field conditions and various typical tasks for residents and retailers. Participants gained a sense of the kind of applications and types of lighting products that Lighting Africa is seeking to encourage.

They were asked, “Of the products that enabled you to see well enough to complete the tasks to your satisfaction, what specific attributes, lighting characteristics, or other information about the product made it superior to the others?” and, “What were the key factors or considerations that made you decide on the product(s) that you chose in the end?” Participants rapidly generated the following responses:

- Durability
- Distribution pattern
- Price versus cost
- Maintenance
- Cost of operation
- Consistency, measured as lumen depreciation per hours, per cycle of use
- Ability to accept multiple voltages
- Appropriate light level for the given task
- Product delivers what it promises in terms of performance
- Whether the product did or did not include mounting options
- Product attributes and desired features for specific applications
- Ease of use
- Durability—the ability to hold up in hostile environments (water, humidity, insect infestation)
- Product information provided
- Color rendering
- Power status indicator (whether the product was fully charged, partially charged, or somewhere in between)
- Duty cycle

- Charge time and conditions
- Available controls (type of switch, ease of use)
- Battery characteristics (such as rechargeable versus non-rechargeable, or, lead-acid versus nickel metal hydride battery chemistry.
- Operating temperature, life/, and light output
- Consumer education information (including operating instructions)

Presentation: Introduction and Lighting Africa Update (*F. Nehme*)

This overview established the framework for discussion of quality assurance. The basic problem is that 1.6 billion people are without access to electricity and live largely in “the dark.” Of this population, as many as 500 million are located in Africa. In absence of the electricity grid, typical households and businesses spend exorbitant sums of money on lighting. As much as \$50-\$100 USD per year or 15% disposable income goes to lighting costs, primarily to purchase kerosene, for typical households in Africa.

Anecdotal evidence suggests that a substantial market opportunity exists in lighting at the “bottom of the pyramid.” This is an opportunity to tap into an estimated US\$38 billion global market. Many lighting products presently for sale in sub-Saharan countries are inefficient, expensive, and unsustainable lighting solutions and energy sources, dominated by kerosene and followed by batteries, propane, candles, and biomass. However, an opportunity for bringing better lighting solutions to the poor permeates the supply chain at many levels; suppliers are looking for new growth opportunities, distributors looking for opportunities to increase sales by extending the workday and making high demand lighting products available to consumers, end-users who desire a more affordable and efficient range of lighting options.

Lighting Africa can take advantage of this opportunity by acting as a market facilitator, reducing key barriers to market entry and accelerating market development. Activities are planned to reduce market entry costs, foster competition and innovation and support long-term market sustainability. Nonetheless, these activities and the overall effort could fail without ‘enforceable’ quality parameters for the products entering this market and without well-informed end-users.

Presentation: Product Quality Assurance Rationale for Lighting Africa (*R. Sturm*)

This session focused on what Lighting Africa should aim for in developing a quality assurance effort. Participants realized that this effort charts new territory because no comprehensive quality assurance effort has ever been developed for off-grid lighting in developing countries, and, that Lighting Africa has specific programmatic needs.

Lighting Africa needs a quality assurance effort to:

- Address market-spoiling concerns (protect the market).
- Complement consumer education efforts.
- Provide a level playing field for competition.
- Protect consumers via access to accurate product information, appropriate pricing, relevant design attributes and other locally developed requirements.
- Provide a quality assurance platform for bulk procurement agents.

Lighting Africa has short-term needs such as requests from bulk procurement agents for quality assurance and requests for procurement specifications and over the longer term, the need to support commercial market development and replication. For example, a certification program supported by a self-sustaining institutional agent could evolve and adapt as the Lighting Africa effort expands and matures. Participants agreed that infrastructure, including institutions and enforcement, would be needed in order to make the quality assurance effort successful.

Participants considered some basic principles for overall project approach and design:

- Enable, not restrict the market
- Let the consumer choose the performance criteria they need
- Work for a range of products, a range of technologies, a range of market segments
- Be practical and enforceable
- Be sustainable and replicable

Presentation: Varying Approaches and Perspectives in Developing Quality Assurance for Off-Grid Lighting (*E. Mills*)

This presentation identified approaches that Lighting Africa might consider for quality assurance, articulated key issues that require consideration, and, provided context for the subsequent case study presentations. The presenter has tested off-grid lighting products in field and laboratory conditions. He reflected on the various potential audiences for information on product quality and performance, including but not limited to end users, product developers, donors, investors, and buyers/sellers of carbon offsets.

Early assessments do indicate some problems with off-grid electric lighting products; there is substantial variance in performance across the range of available products and even between identical products. Tactics to address such problems could include:

- Published quality and performance information
- Advertisements
- Consumer education and point-of-sale materials
- Product catalogs
- Trade literature
- Labeling
- Defined thresholds for procurement
- Program incentives
- Guidelines (voluntary)
- Standards (mandatory)
- Feedback to manufacturers and component suppliers
- Design tool for manufacturers

With so many options to consider, the participants agreed that a quality assurance effort should not limit potentially useful products from entering the market. The presenter noted that laboratory conditions do not represent field conditions and thus products may not perform as anticipated in the field. In developing ways of testing products, lighting quality definitions should be based on consumer preferences and needs rather than external value judgments. Lighting markets worldwide are complex and not monolithic. The program must be responsive to technological improvement.

Key points included:

- A need for well-planned quality assurance efforts
- “Quality” is a subjective term. So, with an array of audiences and potential needs in sub-Saharan Africa, a multi-approach quality assurance effort is required.
- Process and strategy should be guided by a combination of laboratory and field testing and user-preference assessments.
- The effort should be kept harmonious, affordable and in scale with the overall scope of Lighting Africa.

- Any proposed standards should not be set so stringently as to make products unaffordable.

Case Study: Efficient Lighting Initiative Quality Certification Institute (*K. Conway*)

The Efficient Lighting Initiative (ELI) Quality Certification Institute is an internationally recognized program for certifying the performance of efficient lighting products. Initially ELI was a market transformation program intended to promote the use of efficient lighting products. Operating in 7 countries from 2000-2003, ELI increased of unit sales of CFLs in Peru from 250,000 to 5 million; helped to permanently lower prices of CFLs in Argentina; launched municipal street lighting programs in the Czech Republic, Latvia, Peru, and South Africa.

Today the Efficient Lighting Initiative Quality Certification Institute (ELI QCI) is administered by the China Standard Certification Center in Beijing. Reasons for the program's success are traced to its voluntary nature that is dependent on manufacturer and distributor interest in qualifying their products. The institute has a comprehensive network of accredited test laboratories in operating regions. ELI retains several international consultants who establish local networks and it maintains a team of more than 20 global volunteer Ambassadors who promote the program. Most importantly, the program includes a "no questions asked" one-year warranty for certified products.

Key lessons learned from ELI are:

- Developing a quality assurance effort requires a lot of patience, training and time.
- Regional differences present communication and measurement challenges.
- Lack of local, accredited labs discourages manufacturer participation. Increased demand for services is evident due to the global warming concerns, such as "banning incandescent lamps."
- Even though some parties may initially resist stringent specifications, quality assurance efforts can speed improvements in product performance. For example, 6000-hour CFLs are commonplace now, but initially ELI received a lot of pushback for requiring 6000-hour rather than 3000-hour lifetime.
- Random testing reveals strengths and weaknesses in the specifications and in the manufacturers' representations of product performance. Good dialogue and negotiation skills are essential for staff to develop.
- If a quality mark becomes valuable, it is likely to be counterfeited. In such cases, local partners must pursue legal action to stop this practice. Otherwise, the value of the label degrades.

Case Study: Developing Specifications for Solar Lanterns—The Global Approval Program for Photovoltaics (*P. Varadi*)

Two goals were noted: first, the program provides a basis for specifying globally accepted quality products in tenders and second, it aims to protect customers who, without quality assurance, have no way to verify product quality and who would bear significant hardship by purchasing poor quality equipment. Rather than think that quality assurance is expensive, the presenter pointed out that a significant cost is paid for by the thousands of substandard products in the field, costs that not only hurt the pockets of the consumer, but lending institutions, industry, banks, and donor community as well.

Testing alone is insufficient to assure quality, so the Global Approval Program for Photovoltaics (PV GAP) has additional requirements and several qualifying stages: factory inspection and auditing, approval process leading to IEC specification, and testing and re-testing requirements.

To summarize,

- Mature industry could be interested in standardization and certification for solar products only if buyer or consumer “demand” exists.
- Multilateral agencies, governments or utilities that finance or implement bulk procurement programs are interested in photovoltaic (PV) standards and certification for long term reliability and sustainability of procured goods.
- Setting standards and establishing quality mark by itself is not sufficient. If industry is to adopt such standards or obtain such quality marks, the buyers must demand such products. Without a demand-driven incentive industry has little incentive to go through the certification process.
- An internationally accepted standard is preferable to country or regional standards as it permits industry to meet standards that are applicable globally rather than having to test and retest to meet individual country requirements or to tailor products to specific individual country requirements. Both add tremendously to the cost of doing business.

Case Study: The Value of Vigilance—Quality Assurance for Amorphous Silicon PV Modules in the Kenya Solar Market, 1999-2007. (*A. Jacobson*)

The market for PV in Kenya is one of the largest on a per capita basis in developing countries with upwards of 200,000 PV system sales since the 1980s (US\$25,000/year). Although today it represents a \$10 million dollar industry, issues of market spoilage due to poor product quality have impeded the market from realizing greater potential since the technology was introduced in the 1980s. Solar panel “scandals” allowed deficient products to enter the market and caused significant buyer dissatisfaction and product mistrust. After an early scandal in the 1990s that received a considerable amount of negative publicity, efforts to establish PV standards began in 2001 and PV product quality began to improve. However, without adequate testing and compliance enforcement mechanisms in place, a second solar panel scandal erupted in 2004, again receiving negative attention from the media, damaging public interest, harming the reputation of solar technology, and stunting the market.

Solar PV market experiences in Kenya show that:

- Performance of amorphous silicon PV modules varies by brand. Many brands perform near advertised levels, but some brands perform far below nameplate ratings.
- Quality has been a serious concern in Kenya’s PV market. Sales of low performing brands can damage the public interest and the reputation of the technology.
- A successful quality assurance approach emerged slowly.
- International standards are important. In the case of Kenya, they provided the framework for regulation by the Kenyan government.
- Independent testing and information dissemination are critical. Product performance needs to be verified and documented and quality control overseen by the government and private sector.

Generalizing from the experiences in the solar market in Kenya, the presenter cautioned that:

- The danger of market spoiling is real.
- Early action is important to mitigate problems.
- Solutions require a multi-pronged approach.
- International standards are important, but not sufficient. They must be enforced and qualified by independent testing from accredited groups. International collaboration with in-country partners is needed to ensure compliance and testing results must be disseminated through local media and communication networks to ensure transparency of product/brand quality.
- Persistence pays: ongoing efforts are required.
- Low cost testing methods, applied carefully, can be effective.

- Context matters: effective quality assurance and information dissemination strategies should be tailored to local situations.

Off-grid lighting products are smaller and less expensive and typically are retailed “over-the-counter.” It is more difficult to regulate the quality of such “fast-moving goods.” Even if frequent buyers will learn quickly which products to choose for good performance, a number of approaches will facilitate their decision-making. These include:

- Independent Testing and Labeling
- Voluntary Programs
- Standards and Government Regulation
- Communications

Presentation: Quality Assurance Approach Overview: Nomenclature (*K. Conway*)

To ensure that the group had a common language, participants reviewed relevant quality assurance terms and definitions for:

- Specifications
- Standards
- Codes and Regulations

Key differences between each of these methods for achieving quality assurance were highlighted, paying particular note to the typical parties involved in drafting and implementing each, the process involved in creating the product (whether it is a specification, standard, or code/regulation), the period of time it takes to create and incorporate the product, and the typical aspects that are included in each product. Questions to the group included,

- What quality assurance metrics will Lighting Africa develop?
- Who are the individuals or parties that ought to be involved in quality assurance metric development?
- Under what authority should they be developed?

Discussion: Independent testing and labeling

- One quality assurance approach related to testing and labeling is to sell products with warranties or performance guarantees. This kind of assurance comes from the manufacturer side.
- Any independent testing and labeling quality assurance effort will be unsuccessful unless adequate testing procedures and enforcement mechanisms are in place.
- Another related issue that must be addressed is the need for a system to be in place for replacement of components/ product maintenance.
- The certification or labeling system must be designed in such a way that it is adaptive to rapid technological evolution.
- The program must cover a broad spectrum of products and applications.

Discussion: Voluntary Programs

- Questions that participants raised under this topic: “What is the buy-in for manufacturers for voluntary programs? Are there lessons we can draw from, for example, the cell phone experience in Africa?”
- “How can a quality assurance effort be designed that is not burdensome but attractive to manufacturers?”

Discussion: Standards and Government Regulations

- A key issue with standards is enforcement: “Who will be the enforcement body? The government? An independent party? A national or international body?”

- Another issue that needs to be addressed relates to product component disposal or recycling (such as safe disposal/recycling of batteries or CFLs) and how to deal with multiple components; sustainability issues.
- “What kind of legislation, if any, would suffice to ensure quality assurance? National import taxes/fees that protect the consumer from ‘inefficient’ products?”
- “Can we have standards that ensure that a wide range of products with a wide range of qualities can enter the market?” People with disabilities or particular needs might desire certain products, children might desire others, people of differing economic tiers might prefer different product qualities, people are likely to want products that fill a wide array of applications and, thus, the market needs to have a spectrum of products with varying attributes, ergonomics, and price points.

Discussion: Communications

- It is crucial that the product educates the consumer appropriately; consumers should know what to expect of the product based on manufacturer information provided.
- The type, quality, and content of customer education is a critical piece of any quality assurance strategy.
- It is important that the consumer recognizes value of quality assurance.
- One issue: how to ensure consumer understanding of product usage/application. “How can we ensure that places with diverse cultures and languages will interpret the information in the same way? Which languages do we include? How do we know when the information provided is sufficient?”
- Another critical issue: upstream quality assurance and upstream education of manufacturers and distributors; the quality assurance communication strategy must be present at all levels of the supply chain, not just at the level of the end-user.

Day One Summaries

Independent testing and labeling, Model 1: Voluntary Seal of Approval/Certification

The first group explored the quality assurance approach of independent testing and labeling. They identified two distinct approaches under this topic. The first approach is to offer a voluntary seal of approval based on a performance specification. Participating manufacturers would submit their products for testing and if they met the specification, they would be granted the opportunity to certify their products with a seal of approval. Some examples of this type of quality assurance model are the EPA’s ENERGY STAR program, which certifies products based on their energy savings, providing a rating system based on their energy efficiency as compared to conventional energy intensive models; or the PVGAP Quality Mark.

The benefits of a voluntary seal of approval approach is that it often elicits a high level of industry support or buy-in as compared to regulation-based standards in which compliance is mandatory. Additionally, this kind of quality assurance approach may be less litigious than a consumer reports approach, where companies who do not want public exposure about their product performance are more likely to file claims and try and sue for misrepresentation. On the other hand, one risk of this approach is that the program will have little impact if company participation is limited. This approach would only be successful with high volume consumer buy in; manufacturers may consider the program to be a waste of money and time if consumers are not aware of the seal of approval/certificate or do not have faith in its merit.

Independent testing and labeling, Model 2: Consumer Reporting Approach

The products that become certified under this model could be published on a list, providing consumers with information that will allow them to give consumers a basis on which to make informed purchasing decisions; information that will allow them to rate the quality of different products that are available in the marketplace. Another option within this general approach is to randomly test products against a specification or multiple specifications and publish a list of the products that meet or do not meet the specification. This quality assurance approach is based on the idea of a consumer reports based testing and information dissemination model, by which a broad set of products are tested (not limited to participating manufacturers like the other method) and consumers have access to transparent information that is widely available.

One benefit of this approach is that information can be provided on a broad set of products in the market, versus a voluntary approach where only those companies who submit products can receive certification. Potential drawbacks of this approach may include risk of lawsuits and companies who might lash back if their products are involuntarily tested and rated against their will. Additionally, this approach raises substantial questions as to whether the industry at large would support such a method of quality assurance.

With regard to the overall sustainability of this approach, among the topics discussed, the group expressed concern that companies are not likely to support such a quality assurance effort unless they see it as a way to increase their sales, which would require significant consumer interest in purchasing products that have the certification versus those that do not; Companies may be wary of this approach unless they know that there is consumer demand for certified products. In the end of the breakout session, the group identified the following challenges and issues that will need to be considered if the Lighting Africa program chooses a quality assurance approach based on independent testing and labeling.

Challenges and Issues:

- Defining a broadly accepted set of standards and/or test methods
- Gaining manufacturers buy in
- Disseminating information widely; advertising the significance of certification to end users
- Defending label against counterfeiting
- Creating a quality assurance effort that can adapt to the fast pace of technological change – need flexible, nimble program
- Outstanding Issue: quality assurance in a project with bulk procurements is very different than quality assurance in a disaggregated market context; quality assurance approaches may need to be different in those two different contexts.

Voluntary, Opt-In Programs

In their discussion of voluntary, opt-in type programs, group 2 ranked speed, flexibility, and adaptability as some of the key benefits of this type of quality assurance approach, resulting largely from the fact that voluntary quality assurance efforts are based on product value as opposed to regulation; manufacturers choose to submit products for testing and approval rather than being forced to comply with mandatory quality assurance protocol. On the other hand, some of the major concerns with this type of quality assurance approach include risk of low market penetration rate of quality products (companies select to opt-out of product submission) and the challenge of marketing the approach and getting stakeholder engagement- from consumers of different literacy levels with product performance preferences, to the vast array of entrepreneurs across the supply chain.

A key question that needs to be addressed in this type of approach regarding the division of product classes is, “What’s in?” How can we ensure that in a voluntary program, the many layers

of product types that define our general product classes - task lighting, ambient lighting or general illumination, and torch/portable lighting- are adequately covered? While model voluntary quality assurance efforts have been successfully deployed, including ELI, ENERGY STAR, PVGAP, etc., the biggest issues and barriers to overcome with this type of approach are a daunting market; diverse product base; how to effectively build momentum in the market with compelling value proposition; policing and enforcement; and the issue of multifunctional devices that may not fit neatly into any one product category. The group made critical note of the imperative need for any voluntary quality assurance effort to have solid mechanisms in place for ongoing testing and continued public reporting of performance findings.

Standards and Government Regulations

One merit of a quality assurance approach that is standard or regulatory based is that it can be readily applied to provide a quick quality screening in the short-term, especially for applications like bulk procurements. Some of the disadvantages of this approach identified by the group are that the process of standard creation and implementation is likely to be too slow to meet the immediate needs of the program and that the institutions that select and enforce these standards are sometimes weak.

However, despite these issues, the group referenced several successful models including ELI, PVGAP, and the Ugandan CFL procurement. The primary issues and barriers they identified related to the difficulty of creating a product classification system to benchmark products with different performances and applications against each other to accommodate the rapid advancement of lighting technologies. Other challenges articulated in group discussions were issues of consumer buy-in and the lack of funding for standards and regulation programs.

With regard to the sustainability of this approach, the group deemed that a standards and regulations program requires fast tracking the development of specifications. Development of specifications requires recruiting manufacturers and building alliances amongst these. Government uptake from importing and exporting countries is another sustainability consideration. Each specification generation can build on legacy and reference IEC standards. A final condition necessary to achieve sustainability is putting forth standards and regulations via third party to IEC.

This breakout group had two main recommendations for standards and labeling. Firstly, the Lighting Africa program needs to act fast in classifying products and drafting specifications. Secondly, the program should explore and use existing product testing standards. Some of the characteristics that should be tested for are durability, ergonomic controls, environmental factors, materials, and recycling of products and materials.

Communications

For a quality assurance strategy to be effective, communications must be able to adequately address several audiences with varying skill sets, needs, and abilities. The audiences that Lighting Africa must reach include suppliers (manufacturers, distributors, others involved in the supply chain), market facilitators, consumers or end-users, made up of many diverse sub-segments of the population.

The group also discussed the importance of creating brand recognition and designing a communication strategy that will have an initial impact, but also be sustained over the long-term, to both give consumers faith in the quality of the product and retain their buying interest over time. The primary questions around developing a quality assurance strategy for Lighting Africa are many, namely, relating to who will develop it, what methods they will employ, and how they

will employ them. They identified ELI, manufacturers' organizations, local NGOs and others as potential candidates to develop and implement the strategy; radio, mobile phone kiosks and other communication mediums for distributing product quality information; and metrics, standards, certification and other potential quality assurance products as the vehicle through which the quality assurance product information is communicated, the end goal being buy-in at the level of the manufacturer, supplier, and African consumer.

Day Two: Focus on Meeting Lighting Africa Program Needs

Participants focused on several key Lighting Africa needs during the second day:

- Short-term process to support immediate requests by bulk procurement agents and other needs for a quality screening process
- Long-term process to create a self-sustaining and replicable quality assurance model that will support commercial market development over time.

Participants also referred to these objectives:

- Address market spoiling concerns (protect the market);
- Complement consumer education efforts;
- Provide a level playing field for competition;
- Protect African consumers; and
- Provide a platform for bulk procurement agents. The approach or approaches selected must also enable rather than restrict the market, let the consumer choose the performance criteria they need, work for a range of technologies and market segments, be practical and enforceable.

Summary: Elements of a Quality Assurance Process for Bulk Procurement

Participants focused on anticipated procurements of off-grid lighting products for use in WBG programs in sub-Saharan countries.

Method

The main elements of such a bulk procurement program is to use existing international (e.g., IEC) performance specifications, regional or national specifications, or in the absence of either develop project specifications for qualifying products for bulk procurement. Examples of such programs are the solar home systems procurement procedures used in World Bank and GEF-assisted Sri Lanka, Bangladesh, China and the Philippines. As the process is repeated in various country programs, progressively more information and better quality assurance controls should be documented and added to the quality assurance resources. Wherever possible, the task groups or consultants should refer to or incorporate existing international or national standards, guidelines, practices, publications and other consensus-based tools.¹¹ They should also reach out to organizations and associations of industry, business and lighting experts with pertinent experience, in order to broaden the experience base of Lighting Africa efforts.

Short-Term Element 1: Mechanisms for adopting this approach include the following:

- Use Lighting Africa's website and forums as a generic tool for information sharing and announcements.
- Introduce the procurement program implementing teams to Lighting Africa and encourage them to use its resources for their programs. Specifically invite them to use the available specifications and the quality assurance tools, as appropriate.

¹¹ See guidance provided to World Bank staff on procurement of solar home systems at <http://www.worldbank.org/retoolkit>, sublink Project Tools > Technical Standards and Specifications

- Recruit topic and technology experts to serve as a resource to the implementing teams.
- Simultaneously task some of the experts with developing application descriptions (see Table 1 for a classification scheme), assess additional/different product performance specifications and various capacity-building activities.

Short-Term Element 2: Develop a flexible framework for procurements. Using this framework, program implementers could work together to increase their leverage and efficiency in making purchases (market aggregation). Manufacturers and distributors would also become familiar with the framework and therefore be able to respond more promptly and efficiently to requests for bids. When defining requirements, the specifications could indicate accommodations for special populations, such as the elderly and persons with visual impairments.

Table 1. Framework for Procurement Specifications for Lighting Products

<i>Generic Lighting Applications that Describe Users' Most Urgent Needs</i> (Refer to market research, expert experience and implementers' proposals to select important lighting applications)				
Application A Example: Indoor task lighting for reading, sewing and cooking	Application B Example: Indoor ambient lighting for conversations and way finding	Application C Example: Portable lighting for indoor and outdoor way finding	Application D Example: Indoor or outdoor spotlight for kiosks or outdoor vending	Application E Example: Outdoor floodlight for general security and retail facilities
Lighting Requirements for Each Application				
A1, A2, A3...	B1, B2	C1, C2, C3, C4	D1, D2, D3	E1, E2...
Specifications, some with conditional terms, some with ranges and optional terms				
Spec A	Spec B	Spec C	Spec D	Spec E

Characteristics that the participants suggested as critical for all the specifications include:

- Detailed requirements for charge time; duration of operation per full charge; number of duty cycles for which battery is designed; lifetime of product; and, warranty.
- Some lighting metric (appropriate for application and product type), such as luminance, illuminance on a surface at a given distance, etc.
- Integrated, durable systems (no weak or breakable parts; strong connectors; scratch-resistant lenses; sealed from dust and insects, etc.)
- Manufacturer or distributor plan for maintenance or replacement of parts, and also for recycling of batteries or other toxic materials.

Characteristics suggested strongly for the specifications include:

- Power supply standardized for 12-volt DC input, if multiple charging sources are to be accommodated.
- Products that offer multiple functions for users (such as lights integrated with cell phone charging outlet).

Element 3: Develop a systematic means for to provide ongoing feedback on the quality and performance of the modern lighting products.

- Solicit input from all user groups, particularly women through surveys and other feedback mechanisms.
- Post performance test results publicly and establish a simple user rating system so that implementers preparing procurements can benefit from data and user reviews.
- Share this information with manufacturers and distributors to assist them in understanding user needs, behaviors and product preferences.

Element 4: Build capacity locally in Africa to support further procurement and evaluation of modern lighting products.

- Offer training in lighting technology and design for off-grid applications.
- Train laboratory staff to conduct lighting and electrical system performance tests.
- Identify and support the purchase of needed photometric and electrical test equipment.
- Encourage laboratories to begin the accreditation process for relevant lighting evaluations.
- Offer workshops and other educational and organizational activities for importers, distributors and vendors to help build a distribution network for modern lighting products. The objective is to increase access and delivery of these products to urban, peri-urban and rural communities.

Summary: Elements of a Long-Term Quality Assurance Framework

The main feature of a long term quality assurance program is information. That is, support the development of a quality labeling program that a large number of manufacturers will adopt and publicize and educate consumers in using such quality labels in making decisions to purchase off-grid lighting products. It is expected that given the scale of the need – 250 million people without access to grid power by 2030 - commercial marketing and sales channels will need to be employed rather than government-driven bulk procurements. Hence, over the longer term, a quality labeling program is expected to have a greater impact.

Long-Term Element 1: Classification

Classify off-grid lighting products according to their primary application (such as: flashlight, task light, room ambient light, outdoor light, spot light) and their primary charging source (such as: grid based charging, solar charging, mechanical dynamo charging).

Long-Term Element 2: Standardized Metrics

Develop a set of standardized metrics and nomenclature that manufacturers could use to report performance claims for products.

- Metrics may include information about system level performance (such as hours of light delivered from a fully charged device), as well as information about the performance of subsystem components such as batteries, charging systems, and the lights themselves.
- The metrics and nomenclature will vary within the product categories. For example, some of the metrics for a task light would be different than those for a flashlight.

This activity would develop a short and meaningful set of metrics for products in each classification category.

Long-Term Element 3: Seal of Approval

Invite manufacturers to voluntarily participate in the quality assurance effort. Participating companies would benefit by having a Lighting Africa “seal of approval” on their product labels. The significance of the seal and the information contained on it would vary according to the details of the program.

Option 1: Truth in Advertising

Use independent laboratory testing to confirm the performance claims of participating manufacturers in order to verify “truth in advertising.” Manufacturers whose claims are confirmed would be in a position to include the Lighting Africa “seal of approval” on their product label.

Option 2: Minimum Performance Specifications

Develop a set of minimum performance specifications for off-grid lighting products. Use independent laboratory testing to verify if products meet the minimum specifications. Products that comply would be allowed to use the Lighting Africa “seal of approval” and “rating.”

Products of participating companies must meet the minimum performance specifications in all relevant categories and manufacturing facilities need to meet ISO 9000 or similar standard to assure production processes result in consistent quality products, in order to receive the “seal of approval.” Then, products of participating companies would receive rating scores (such as one, two, or three stars) according to the test results for each performance metric. The product label would include the rating information for each metric along with the “seal of approval.” For example, a solar-charged task light with an undersized battery, an appropriately sized and high performing solar module, and adequate and somewhat evenly distributed light output might receive one star for the battery, three stars for solar charging, and two stars for lighting output.

Option 3: Warranty

Participating companies would be required to offer a warranty for their products. Products that fail prior to the end of the warranty period would be replaced at the cost of the manufacturer. However, since many retail vendors do not accept returns regardless of the policies of the manufacturer of the products, success of this quality assurance option would depend on the development of a system for receiving and replacing defective products.

Lighting Africa could sign an agreement with a business that has an extensive supply chain in the respective country to act as the receiving agent for products made by any participating manufacturer that fail within the warranty period.

- Participating companies could receive a Lighting Africa “seal of approval” sticker or imprint for use on the products covered by warranties.
- Customers who wish to return products would need to bring a receipt that verifies the date of purchase.
- The business providing the receiving service in each country would either need to maintain a stock of replacement products at its shops or customers would have to come back to the shop after the replacement item had been shipped to the distribution point. The former approach would be considerably more convenient for consumers, but it would also be more complex and costly to manage.

An added benefit of this approach is that it would allow the Lighting Africa program to collect information about product durability and failure mechanisms. A diagnostic program could evaluate the cause of failure for returned products. The information could then be forwarded on to the manufacturers of the respective products who could then correct problems and improve their product design.

Long-Term Element 4: “Consumer Reporting” Approach

Use a “consumer reporting” approach to disseminate information about the quality of off-grid lighting products sold in countries included in the Lighting Africa project. In this element of the quality assurance strategy, products from a variety of manufacturers (including both those who have chosen to participate in the initiative as well as those who have not) would be procured on a random basis from retail sales points in the respective countries. The performance of these products would be tested using a standard set of metrics. The results would be disseminated and published through local media outlets in the respective countries.

The central goal of this “consumer reporting” approach is to provide buyers of off-grid lighting products with information that they can use to make informed purchasing decisions. The success of this approach would depend heavily on the use of effective information dissemination strategies. These could include print media, radio, and other dissemination strategies.

While a portion of the effort would focus on the dissemination of information to potential end-users, the program could also emphasize the delivery of information to a variety of other groups that make purchasing decisions. For example, import companies and retail vendors frequently make decisions about which products to purchase and sell in the absence of complete information about product quality. Dissemination of product performance results to these agents could encourage them to buy higher quality products. Ideally, product testing would be conducted by testing laboratories in Africa, using relatively low-cost testing methods. To achieve this, it would be critical to identify and work with groups with an appropriate level of scientific and technical expertise. Testing and reporting should be carried out on a regular, ongoing basis in order to keep up with technology changes and the introduction of new products.

Long-Term Element 5: Consumer Education Campaign

Mount a consumer education campaign to inform people about quality assurance efforts associated with the Lighting Africa project. This campaign would be used to raise awareness about the need for quality assurance in markets for off-grid lighting products, to achieve brand recognition for the Lighting Africa “seal of approval” logo, and to explain how people can use information provided by Lighting Africa to make informed purchasing decisions.

OUTCOMES

At the end of the meeting, most participants appeared to support a quality assurance effort that included activities consistent with those described above. Much of the conversation and debate revolved around the various options listed under Long-Term Element 3, “Seal of Approval.”

Some argued in favor of testing to confirm “truth in advertising” on the grounds that this would encourage participating manufacturers to develop high quality off-grid lights without placing undue restrictions on product design. Their concern was that the development of a set of minimum standards could inadvertently restrict design options for participating manufacturers. In addition, some participants expressed concern that setting minimum standards would restrict consumers’ ability to make informed choices to purchase lower quality, lower cost products should they choose to do so. Yet a “truth in advertising” option would, in theory at least, facilitate such a choice because manufacturers of both low and high quality products would be in a position to participate in the program, provided that they reported the performance of their product honestly.

Others countered that the “truth in advertising” approach described under could be confusing to potential consumers, because even low quality products could earn the Lighting Africa “seal of approval” simply by honestly reporting product performance. In such a case, some consumers might misinterpret the presence of the “seal of approval” as an endorsement of the quality of the product rather than a simple confirmation of the advertised performance information. Others maintained that products associated with the Lighting Africa program should meet minimum performance standards in order to earn any “seal of approval.” A program to facilitate the use of warranties was discussed by some participants who noted that it had been used successfully in other programs, including the Efficient Lighting Initiative.

Recommendations

Several participants noted that, in the absence of information about costs and availability of funds for Lighting Africa, it was difficult to choose between the various program strategies and options. So, a future Lighting Africa task is to estimate costs and outline a budget for the activities suggested in the workshop.

Participants also discussed risk management issues. Several noted that the greatest potential risk was that the Lighting Africa’s quality assurance effort could be ineffective. This could occur if most manufacturers chose not to participate because they would not derive sufficient benefit from receiving the “seal of approval.” Or, the consumer education and information dissemination efforts might be ineffective or inadequate, and then the program’s resources might be insufficient to stem the tide of low quality products in the market.

A second set of risks relates to “consumer reporting,” or testing and information dissemination. Here, disgruntled manufacturers of products that were reported to have poor performance might dispute the results of Lighting Africa’s reports. In extreme cases, disputes could lead to litigation. If this element were included in the program, ensuring that tests are carried out carefully and accurately using consensus procedures would reduce risk. It would also be necessary to include funding in the budget to cover legal costs associated with potential litigation.

A third type of risk is long-term program sustainability. The program might be successful as long as it receives adequate funding from initial sponsors. After sponsor funding expires, the quality assurance effort could cease, too. The original funding agencies may also choose to provide the

program with a budget that declines progressively over time. This approach could allow for a gradual transition towards self-sustained program operation.

Finally, it is possible that the program would be associated with one or more additional unintended outcomes. While it is generally preferable to anticipate and avoid negative outcomes, these are always possible. It is therefore important to attempt to design a program that is flexible enough to adapt as the need arises.

Next Steps

While the discussions at the workshop were productive, several tasks should be completed before finalizing the detailed design of the program.

- Solicit feedback from stakeholders. This activity should include conversations with off-grid lighting product manufacturers, including both small and large firms. In addition, the process should include consultation with import and distribution companies as well as retail vendors in the respective African countries. Focus groups with potential consumers could offer input about the potential effectiveness of the various approaches and options.
- Evaluate the costs associated with the various quality assurance strategies and options.
- Carry out a more detailed risk assessment of the various options. A “SWOT analysis” (strengths, weaknesses, opportunities and threats) could evaluate the benefits and risks of the various options. A literature review of existing quality assurance efforts could also provide valuable information for program design.

Follow-up discussions continue amongst the workshop participants and Lighting Africa team members. Public comments on quality assurance are welcomed and posted through the Lighting Africa website forums. Emergent from the workshop, Lighting Africa has identified two independent yet interrelated strategies for meeting Lighting Africa’s product quality assurance needs.

The first strategy serves the short-term needs of the WBG’s lighting product procurements. To begin this process, Lighting Africa will support the identification and testing of a sample of solar lanterns that can meet the daily use cycles that rural consumers desire (for example, minimum 3-4 hours/day of area lighting comparable to 25 watt (W) incandescent light. The solar lanterns would be tested according to PVGAP Solar Lantern Recommended Specifications (PVR11A), Amendment 1.¹² Accordingly, a contract has been competitively awarded to PVGAP to further refine PVR11A to incorporate Nickel Metal Hydride batteries and to test a sample of ten solar lanterns. The lanterns will be selected based on a number of criteria, among them, ability to provide a daily duty cycle of at least 3 hours of light, days of autonomy of battery, significant volume of sales especially in Africa, ISO 9000 certification of manufacturing facility. Those that meet the specifications may be eligible to receive a PVGAP quality seal. The main tasks are the following:

- Task 1: Conduct a market overview of available PV Solar Lanterns in the market (e.g., in producing countries in Asia, USA, Europe and Africa) and select and procure 10 lanterns for testing against PVR11A standard. This selection will be done on the basis of market share and hence relevance. Market intelligence with regard to “good” and “bad” lanterns in this group will be collected. Both technologies described in PVR11A as well as

¹² See PVR11A Amendment 1, February 11, 2008 forthcoming at <http://www.pvgap.org> and PVGAP, “Portable Solar Photovoltaic Lanterns: Performance and Certification Specification, and Type Approval,” ESMAP Technical Paper No. 078, August 2005. <http://www.esmap.org/filez/pubs/07805WholeReportFinal3106.pdf>

- newer technologies (e.g. NiMH batteries and LED lights) will be included. A selection will be made based on market share, technology and future-orientation.
- Task 2: Review the applicability of IEC Standard 61951 for NiMH batteries and if needed propose corrections. PVRS11A will be revised accordingly to include NiMH batteries.
 - Task 3: Establish the PVRS11A testing procedure in the form of a Test Report Form and instruction to laboratories.
 - Task 4: Test 10 Solar Lanterns according to PVRS11A procedure and using Test Report Form. Testing will be done at the Photovoltaic and Wind Quality Test Center in Beijing, China and TÜV Rhineland in Köln, Germany. Both test centers are accredited for testing according to ISO 17025 standard.
 - Task 5: Review and analysis of test results with a focus on both, products and testing methodology. Based on outcome of tests and analysis, the scope of PVRS11A and/or the test sequence within PVRS11A will be reviewed for possible modifications.
 - Task 6: Communicate results and analysis to manufacturers and to procurement agencies.
 - Task 7: Support the award of PVGAP Quality Seal for qualified solar lanterns.

As off-grid LED-based lighting is at a nascent stage of development compared to CFL-based lighting, Lighting Africa will support the development of a “Quick Screening” approach to selecting LED lighting products, in order not to delay consumers benefiting from such advances. The screening methodology could be used by procurement agencies to qualify LED lighting products for bulk or programmatic procurements. The main elements of this work comprises of developing a procurement specification and test procedure for undertaking a “quick” quality/usability screening to be used for procuring LED lights and to test up to 30 LED-based lights to screen products that meet the requirement. Tasks to be undertaken are:

- Task 1: Review Existing Products, Specifications, Testing Procedures and conduct relatively simple technical assessment of about 10-15 commonly available solar PV, DC recharging, grid charging, and mechanically charged LED lighting systems intended for use in unelectrified areas of the developing world that cover a domain of applications encompassing task lighting, ambient lighting, portable light.
- Task 2: Develop a screening methodology for LED lighting products to assess relative performance with respect to quality and usability. The methodology will comprise a specification and test procedures for stand-alone ambient, task and portable LED lighting systems.
- Task 3: Test and rate up to 30 LED lights using the screening methodology.
- Task 4: Report on the results and publicize the results through Lighting Africa forums.

Building on these findings and experiences, Lighting Africa will work with international standards institutes to develop formal specifications and quality screening methods to LED lights and help build capacity locally in Africa to support further procurement and evaluation of modern lighting products.

The second strategy is longer-term and incorporates many of the suggestions from the workshop, organizing the elements in a format similar to other “Fair Trade” product evaluation and certification programs. Many of the issues discussed in the workshop concerned generic product features—expectations that a user would have of a product, whether it was a lighting device or some other type of device or service. At the heart of Fair Trade programs are transparent agreements and practices between providers and purchasers that enable all involved in a market transaction to benefit. Users and providers agree that the products and services that they exchange will fairly benefit both parties. Some features noted by workshop participants as desirable for buyers include:

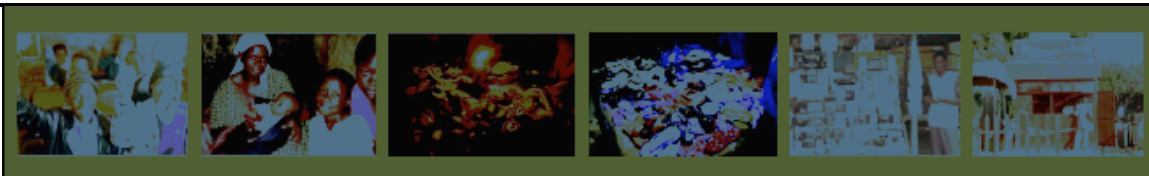
- Durability
- Safety
- Ease-of-use
- Appropriate for diverse populations (age, visual ability, gender, occupation)
- Options available for re-use or recycling of products
- Reasonable warranties from distributors or manufacturers
- Clear labeling, product information and ongoing education available from a local source, but developed from a central location for consistency.

As Lighting Africa develops a marketplace for energy-efficient modern lighting for use in areas that lack consistent access to an electrical grid, program participants could examine existing Fair Trade programs for models that could be implemented in sub-Saharan Africa¹³ By facilitating consensus among manufacturers and purchasers—both of which could be in developing countries—Lighting Africa could set a precedent for Fair Trade principles and practices in the global lighting industry.

¹³ The following organizations offer services and networking that could be explored by Lighting Africa: Cooperation for Fair Trade in Africa (COFTA): < <http://openentry.com/cofta/EN/index.html>>; European Fair Trade Association (EFTA): < <http://www.european-fair-trade-association.org/> > Fairtrade Labeling Organizations (FLO) International: <<http://www.fairtrade.net/home.html>>; International Federation for Alternative Trade Network/International Fair Trade Association: <www.ifat.org>; Network of European Worldshops! (NEWS!): < <http://www.worldshops.org/>>

Annex 1

WORKSHOP BACKGROUND



Lighting Africa
Catalyzing Markets for Modern Lighting



Workshop Background

Due to rapid efficiency gains, high light output, low power requirements, design flexibility and affordability, modern lighting technologies such as CFLs and LEDs hold the promise of providing superior alternatives to fuel-based lighting. In response to these developments, the World Bank Group (WBG) has formulated “Lighting Africa,” a market-driven global initiative to mobilize the private sector to accelerate the development of modern off-grid lighting markets to provide poor households and small businesses with sustainable lighting, in turn, promulgating market and human development. To that end, the WBG is undertaking a number of activities in partnership with the global lighting industry to support the development of this market. These activities range from facilitating international business partnerships to identifying and financially rewarding firms providing innovative off-grid lighting solutions. One of the key activities the WBG will coordinate under its Lighting Africa project will be the development of performance specifications for modern off-grid lighting products. WBG will also consider how to encourage national and local government entities to develop or adopt minimum standards for safety and energy efficiency for lighting products and systems.

The Need for Quality Control for Off-Grid Lighting Products

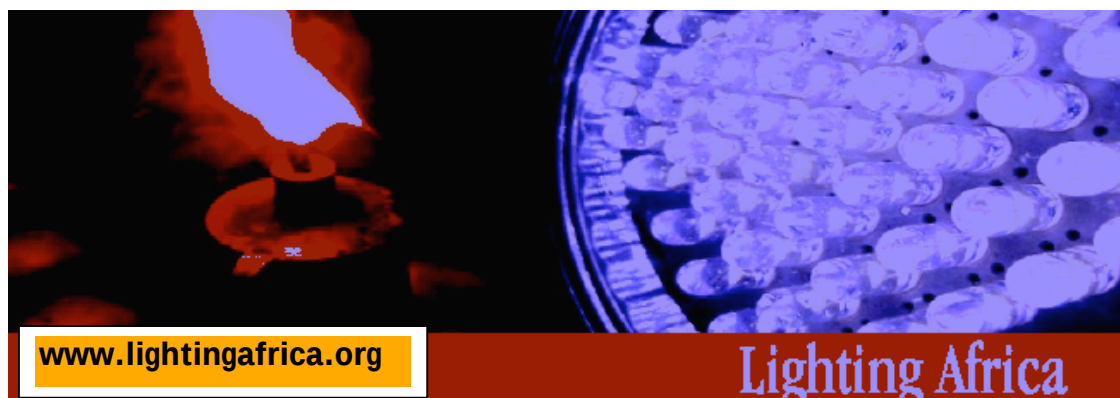
While performance specifications and testing procedures for modern grid-connected lighting systems are widely used by the lighting and energy industries and by environmental advocates, adequate performance specifications for off-grid lighting products have yet to be fully developed. For example, LED specifications and testing procedures are just beginning to be developed in Europe, North America and Australia. Moreover, existing minimum standards that address electrical safety and energy efficiency for lighting components and systems are limited in their applicability to off-grid lighting systems because they are typically component-specific rather than finished product or system-based. Also, compliance with minimum standards is usually

tested in laboratory conditions that may not reflect field usage conditions. Furthermore, testing is expensive, and requires accredited testing facilities.

Without performance specifications, standardized testing procedures or accredited testing laboratories, a strong potential exists for substandard products to enter the market in Africa, eventually yielding significant buyer dissatisfaction and market spoilage. While white light-emitting diodes (WLEDs) offer an excellent modern lighting opportunity for off-grid applications, the prospects for poor performance are high because many poor quality and inexpensive components are available. Unless all components (LED lamp, heat sink, power storage, electrical drivers, power supplies, optics and housings) are compatible and optimized, the resulting off-grid product may perform poorly and fail early. Recent product tests of WLED lighting systems and components have identified potential market spoilers^{14,15,16}. On behalf of the populations that WBG intends to address, Lighting Africa will explore ways to best identify high-performance products.

WBG Objective

The objective of the WBG in creating off-grid lighting performance specifications and test procedures as part of the Lighting Africa project is three-fold: (1) to support industry/manufacturers in developing a sustainable market for their products (for example, by creating a level playing field, providing necessary metrics/benchmarks for product design, and fostering market competition); (2) to protect the buyer from purchasing inferior products or those that do not satisfy their intended application, especially low-income buyers who cannot afford to incur substantial losses if products fail to meet their expectations and needs; and (3) to protect the WBG from facilitating the introduction of poorly-performing or unsafe products that have the potential to cause long-term market damage.



¹⁴ United States Department of Energy, Solid-State Lighting: DOE SSL Commercial Product Testing Program. Download reports at: http://www.netl.doe.gov/ssl/comm_testing.htm. Evaluations of LED lighting products.

¹⁵ Mills, Evan and Arne Jacobsen, The Need for Independent Quality and Performance Testing of Emerging Off-grid White-LED Illumination Systems for Developing Countries; and, Research Memo #1. Downloads at The Lumina Project: < <http://light.lbl.gov/>>. Evaluations of LEDs.

¹⁶ Conway, Kathryn. Niche by Niche, LEDs Offer Excellent Service and Savings [forthcoming proceedings]. Download presentation at: "Status, Prospects and Strategies for LEDs in General Lighting," Ispra, Italy, European Commission: <http://re.jrc.cec.eu.int/energyefficiency/html/Workshop_LED_34052007.htm>. Evaluation of torches.

Annex 2

WORLD BANK GROUP PRODUCT QUALITY ASSURANCE WORKSHOP

Airlie Center, VA

October 14-16, 2007

Workshop Commences- Sunday 14 October, 2007

3:00 pm - 6:00 pm	Participant Arrival @ Airlie Center - Check in at Airlie House
6:00 pm - 6:30 pm	Welcome & Introductions - Forge House (Our Meeting Space for the duration of the Workshop) Lindsay Madeira & All
6:30 pm - 7:30 pm	Dinner- Airlie House Dining Room
7:30 pm - 8:00 pm	Introduction to Lighting Africa- Forge House Presenter: Fabio Nehme
8:00 pm - 9:00 pm	Group Activity: Using Off-Grid Lighting To See Moderators: Arne Jacobson and Kathryn Conway

DAY 1 – Monday, 15 October, 2007

8:00 am - 9:00 am	Breakfast- Airlie House Dining Room
9:00 am- 9:10am	Welcome to the Day- Forge House Lindsay Madeira
9:10 am - 9:30 am	SESSION 1: Quality Assurance (QA) Rationale for LA Project Presenter: Russell Sturm
9:30 am - 9:55 am	Group Task 1 Begin defining a working list of different QA approaches that LA may undertake. Introduce the roadmap. Moderator: Kathryn Conway
	Group Output 1 Working list of various QA approaches that LA may undertake
10:00 am - 10:20 am	SESSION 2: Varying Approaches & Perspectives in Developing QA for Off-Grid Lighting Presenter: Evan Mills
10:20 am - 10:35 am	Morning Break
10:40 am - 11:00 am	Case Study 1: Efficient Lighting Initiative (ELI) Quality Certification Institute Presenter: Kathryn Conway

11:05 am - 11:25am	Case Study 2: PVGAP-Developing Specifications for Solar Lanterns in Developing Country Presenter: A Presenters: Frank Wouters & Peter Varadi			
11:30 am - 11:50 am	Case Study 3: Experiences with Developing QA for PV in Africa Presenter: Arne Jacobson			
11:50 am- 12:30 pm	Group Task 2 (1) Summarize the lessons Learned from the Experiences outlined in the Case Studies (2) Draft a List of Specific Lessons that Apply to LA Goals Moderator: Arne Jacobson			
	Group Output 2 Detailed list of specific lessons for LA to consider when formulating LA QA strategy			
12:30 pm - 1:20 pm	Lunch- Airlie House Dining Room			
	SESSION 3: QA Approach Overview Moderator: Kathryn Conway			
1:25 pm - 2:15 pm	Group Task 3 Define the range of QA approaches for off-grid lighting applications			
	Group Output 3 Comprehensive list of QA approaches for off-grid lighting applications			
2:15 pm - 3:45 pm	SESSION 4: QA Approach Evaluation in Context of LA Objectives Moderator: Kathryn Conway			
	Group Task 4 Evaluate the pros and cons of each approach defined in the previous sessions Afternoon Breakout Sessions			
	Group 1 Moderator: Arne Jacobson	Group 2 Moderator: Evan Mills	Group 3 Moderator: Kathryn Conway	Group 4 Moderator: N. Narendren
	Group Output 4 Comprehensive list outlining the benefits and consequences of each approach			
3:45 pm - 4:00 pm	Afternoon Break			
4:00 pm -5:45 pm	Group Task 5 Based on the pros and cons of the various approaches, narrow approach options until 1 or the few best are identified Moderator: Kathryn Conway			
	Group Output 5 List of the 1 or few best approaches LA should undertake			
5:45 pm - 6:00 pm	SESSION 5: DAY 1 WRAP-UP: Outstanding Topics Moderator: Arne Jacobson			
	Group Task 6 Create a working list of any outstanding issues from DAY 1 that require further group review			
	Group Output 6 Working List of outstanding topics that require further group review before the culmination of the Workshop			

6:00 pm - 7:30 pm	Leisure Time (Enjoy recreational activities visit the pub, relax!)
7:30 pm - 8:30 pm	Dinner- Airlie House Dining Room

DAY 2 - Tuesday, 16 October, 2007

8:00 am - 9:00 am	Breakfast- Airlie Dining Room
9:00 am- 9:10 am	Welcome to the Day Lindsay Madeira
9:10 am - 12:15 pm	SESSION 6: Process for Implementing each Approach (group may decide to formulate break-out groups) Moderator: Kathryn Conway
	Group Task 7 Define process for implementing each approach (Detail the Road Map- i.e. identifying specific steps, components, tasks, time line, etc.)
	Morning Break
	Group Output 7 Explanation of process for implementing each approach
12:15 pm - 1:00 pm	Lunch- Airlie Dining Room
1:00 pm - 3:00 pm	SESSION 7: DAY 2 WRAP-UP: Outstanding Topics Moderator: Arne Jacobson
	Group Task 8 Other outstanding Issues and potential ways to respond to them (i.e. technical issues
	Group Output 8 Final list of outstanding issues and potential responses
3:00 pm - 3:20 pm	Final Thoughts Russell Sturm
3:20 pm - 3:30 pm	Return Travel Logistics Lindsay Madeira

Session Overviews

WORKSHOP COMMENCES, SUNDAY 14 OCT 2007 6PM

WELCOME & INTRODUCTIONS

Lindsay Madeira will welcome the group and initiate introductions.

INTRODUCTION TO LIGHTING AFRICA

Fabio Nehme will provide a general overview of the project including key activities and objectives.

EVENING ACTIVITY

After introductions and dinner, Arne Jacobson and Kathryn Conway will lead the group in a fun group activity, “Using off-grid Lighting Products to See,” in which we will take advantage of the darkness of the night and use various off-grid lighting products in a variety of applications. Participants will have the chance to try and undertake different tasks using different kinds of light to get a sense of the kind of applications and types of light that Lighting Africa is seeking to provide. (Participants are encouraged to bring their favorite portable off-grid lighting devices!)

DAY 1

Why Does LA need Quality Assurance?

SESSION 1: LA Quality Assurance (QA) Rational

Russell Sturm will start us off by providing some background on the importance of quality assurance in the context of Lighting Africa and clarify what Lighting Africa seeks to achieve from a QA program.

Group Task 1: As a first brainstorming session, the group will create a preliminary list of QA approaches which will be expanded upon and refined during the course of the workshop. The goal by the end of Day 1 is to narrow this list to the 1 or few most appropriate QA approaches that LA may undertake to formulate and implement a QA strategy for Lighting Africa. By the end of Day 2, the goal is to have created a refined, detailed approach or set of approaches that are tightly aligned with LA goals and objectives.

Group Output 1: Working list of QA approaches based on first presentation, to be expanded during the course of the workshop.

What lessons have we learned from previous attempts to develop QA for Off-Grid Lighting in Developing Countries that we can use to inform Lighting Africa QA strategy?

SESSION 2: Varying Approaches & Perspectives in Developing QA for Off-grid lighting

In the second session, Evan Mills will provide some context on varying approaches and perspectives for developing QA for off-grid lighting. He will begin with reflections on the various potential audiences for information on product quality and performance, including but not limited to end users, product developers, donors, investors, and buyers/sellers of carbon offsets. The current need for quality assurance protocols will then be affirmed based on evidence from early assessments of problems with off-grid electric lighting products. The discussion will outline various uses of quality and performance information for reaching the desired audiences and helping off-grid lighting markets to function well, as well as potential pitfalls to keep in mind. Note will be made of the importance of identifying consumer preferences and needs within the Lighting Africa target population early on, and using that information to inform the establishment of

quality assurance protocols. The primary outcome of this presentation is to begin to identifying an array of approaches that are aligned with LA goals, and to provide context for the subsequent case study presentations.

Following Evan's presentation, we will hear specific case studies in order to reveal (1) actual QA approaches that have been undertaken for off-grid lighting and (2) identify "lessons learned" in developing Quality Assurance (QA) programs for off-grid applications in developing countries. Case studies on IFC's Efficient Lighting Initiative (ELI) (Kathryn Conway), the WBG experience with designing solar lantern specifications (Peter Varadi & Frank Wouters), and experiences developing photovoltaic standards in Africa will be presented (Arne Jacobson).

The objective of Session 2 is for the group to:

- Gain an understanding of some of the QA approaches for off-grid lighting applications that have been undertaken to date.
- Summarize the key "lessons learned" in the development and implementation of each approach.
- Identify which lessons, if any, the WBG should consider in defining the Lighting Africa QA strategy.

Group Task 2: To meet this objective, Group Task 2 will involve two sub tasks:

- (1) Following the case study presentations, the group will summarize the "lessons learned" and formulate them into a comprehensive list.
- (2) The group will then review this list and select specific lessons that are most relevant to Lighting Africa.

Group Output 2: Detailed list of specific lessons for LA to consider when formulating LA QA Strategy

What Approaches exist for developing QA for off-grid lighting products?

SESSION 3: QA Approach Overview

The function of session 3 is to expand upon the approaches identified in sessions 1 & 2 to expose the spectrum of potential approaches for ensuring QA for off-grid lighting products. Kathryn Conway will lead the group to identify potential approaches and perspectives that have not yet been articulated.

For example, some approaches may include:

- (i) Creating buyer-oriented certification programs that ensure truth in advertising
- (ii) Developing national and internationally accredited performance and testing standards (e.g. facilitated through ANSI, IEC, CIE, or others)
- (iii) Developing standards and/or certification procedures in-house or outsourcing them to a third party(s) service such as the Efficient Lighting Quality Certification Institute (ELI)
- (iv) Developing project-specific procurement specifications and then publishing lists of qualified products. The role of local market research in identifying and articulating buyer and user needs will also be discussed.

Group Task 3: Identify the range of Quality Assurance approaches that Lighting Africa can undertake to ensure quality control for off-grid lighting products.

Group Output 3: Comprehensive List of Quality Assurance Approaches for Off-Grid Lighting Applications

Which Approach or Approaches Best Serve the Objectives of Lighting Africa?

SESSION 4: QA Approach Evaluation in Context of LA Objectives

The goal of this final session of Day 1 is to evaluate the various QA approaches outlined in Session 3 as they pertain to the goals of Lighting Africa and generate a final list of the 1 or few approaches that the group determines best serves the project. In order to harness the wealth of participant experience and give everyone a chance to voice their opinions, the session will commence with group breakout sessions where participants will have the opportunity to discuss and evaluate the various approaches in small working groups. A moderator will be assigned to each working group, as outlined in the agenda. Following the breakout sessions, the larger group will reunite to review sub-group findings and, together, narrow the approaches until 1 or few remain.

Group Task 4: The session will begin by dividing the group into 3-4 smaller working groups. The groups will be assigned to evaluate the pros and cons of the various approaches defined in session 3 and generate a comprehensive list outlining the benefits and consequences of each approach.

Group Output 4: Comprehensive list outlining the benefits and consequences of each approach.

Group Task 5: Based on the pros and cons of the various approaches, narrow QA approach options until 1 or the few Best are identified

Group Output 5: List of the 1 or few best QA approaches Lighting Africa may undertake

What outstanding topics from Day 1 merit further discussion?

SESSION 5: Day 1 Wrap-Up: Outstanding Topics

Group Task 6: In order to ensure that relevant topics identified in Day 1 are adequately addressed by the conclusion of the workshop, the group will spend the last 15 minutes of the day creating a working list of outstanding issues which will be re-evaluated, revised, and addressed by the end of the workshop.

Group Output 6: Working List of Outstanding Topics for further review before the end of the workshop

DAY 2

The function of Day 2 is to:

- (1) Define the process for implementing the 1 or short list of QA approaches identified in session 4, noting specific action steps, time tables, etc.
- (2) Discuss outstanding topics that LA ought to consider in developing and implementing its QA process and propose appropriate responses for each

Day 2 is intentionally less structured than Day 1 to build fluidity into the agenda in the event that, based upon the results of Day 1, the group determines a better course of action to achieve workshop goals than is currently outlined in the agenda.

What are the details of implementing the QA Approach(s)? How to implement, who to engage, what specific steps to undertake, what components to include, etc?

SESSION 6: QA Implementation Process

Session 6 will shed light on the basic implementation processes associated with the 1 or few best approaches identified in session 4. The function of the session is to provide the Lighting Africa team with direction as to how to go about implementing the approach or approaches the group has deemed most appropriate or aligned with LA goals.

Kathryn Conway will lead the group in detailing the road map presented in session 2 on Day 1. This exercise will be critical for providing the scope and specifics needed to move the approach or approaches identified in earlier sessions towards actual implementation.

Key details may include:

- Specific steps, stages, tasks and sub tasks to be undertaken for the approach or approaches
- Identification of relevant players and contacts that may be useful to engage
- Identification of specific time lines and targets

Ultimately, it will be up to the group to decide the best way to fill in this road map(s). The group will also need to decide to make best use of group expertise. For example, the group may decide to breakout into sub groups, for example, by (1) approach (if more than one has been selected each group tackles a different approach) and/or (2) topics within an approach or across different approaches (e.g. certification, labeling, conformance assessment & testing procedures, delisting, consumer awareness and education, etc.).

The open-endedness of this session format is likely to provide several participants with the opportunity to act in a moderating role, and to give all participants the chance to weigh-in on how best to constructively lead the group to achieve session objectives.

Group Task 7: The group will be asked to identify the process for implementing the 1 or few approaches identified in session 4 and outline key variables and details

Group Output 7: Explanation of Process for Implementing Each Approach

What Outstanding topics still need to be addressed? What are the appropriate ways to address them?

SESSION 7: WRAP-UP: Review of Outstanding topics and Identification of ways to address them

Session 7 is designed to provide a space for discussion about outstanding topics that have been defined during prior sessions but that merit further group review.

This will involve 2 sub tasks:

- (1) The group will review the working list of outstanding issues drafted at the conclusion of Day 1, add any new topics identified during the course of Day 2, and select key issues to be addressed in the wrap-up session. Potential topics may include technical aspects that impact QA strategy, the role of different players in the QA process, best practices in seeking and utilizing external assistance, in-country factors that may affect LA QA process or selection of approach, etc.
- (2) The group will provide potential responses to the outstanding topics

Group Task 8: The group will review and revise the working list of outstanding topics and provide appropriate Responses to them

Group Output 8: Final List of Outstanding Issues and Potential Responses to address them

FINAL COMMENTS

Russell Sturm will conclude by opening the floor to participants to iterate final comments.

RETURN TRAVEL LOGISTICS

Finally, a few minutes will be allotted to clarifying departing travel logistics for participants to reach their return travel destination.

Workshop Participants

Kathryn M. Conway

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Mark Hankins

Rural Lighting Specialist, Nairobi, Kenya

Arne Jacobson

Humboldt State University

Marc Ledbetter

Pacific Northwest National Lab (PNNL)

Jeffrey Miller

Pivotal Lighting Design

Evan Mills

Lawrence Berkeley National Lab (LBNL)

N. Narendren

Rensselaer Polytechnic Institute

Kristine Pearson

Freeplay Foundation

Patric Reiff

Osram

Peter Varadi

PVGAP

Hans Welchen

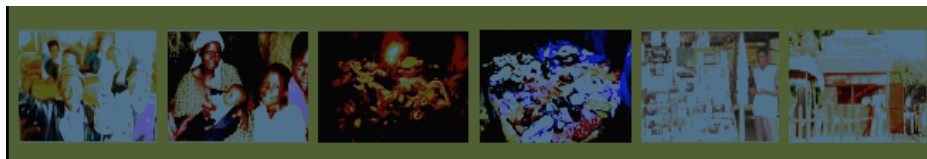
Philips, Innovative Energy Concepts

WBG Lighting Africa Team

Patrick Avato, Anil Cabraal, Lindsay Madeira, Fabio Nehme, Russell Sturm

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Annex 3

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Annex 4

WORKSHOP PRESENTATIONS (Compiled on CD included within
these proceedings)