Base Period
Final Report:
Volume 1

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The U.S. Trade and Development Agency

The U.S. Trade and Development Agency helps companies create U.S. jobs through the export of U.S. goods and services for priority development projects in emerging economies. USTDA links U.S. businesses to export opportunities by funding project planning activities, pilot projects, and reverse trade missions while creating sustainable infrastructure and economic growth in partner countries.

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"…the problem is not going to be private-sector financing. The problem is going to be getting the rules right, creating the framework whereby we can build to scale rapidly."

- Barack Obama

EXECUTIVE SUMMARY

On September 30, 2015, the American National Standards Institute (ANSI) was awarded the U.S. Trade and Development Agency (USTDA)-sponsored initiative, the U.S.-Africa Clean Energy Standards Program (CESP). This program supports a series of workshops in Sub Saharan Africa (SSA) focusing on standards in the clean energy space in coordination with Power Africa. Over the subsequent 18 months, ANSI successfully executed three workshops and completed the base period of the CESP.

As the SSA region works to build its energy infrastructure, the safety and reliability of energy supplies is paramount to ensuring quality energy access across the continent. These components highlight the need for robust standards and conformity assessment to support the uptake and development of solutions to meet Africa's energy shortfalls. The growing need for reliable energy presents an opportunity for U.S. businesses to aid the development of Africa's energy infrastructure and to tap into one of the world's most rapidly expanding energy markets. With this reality in mind, CESP workshops were organized with the objective of promoting economic growth and the expansion of energy access in SSA while simultaneously helping American businesses export clean energy technology and products to the region.

During the program's base period, the CESP organized three workshops across SSA covering three topics: electrical safety, solar mini-grid, and energy storage. These events were located in Cape Town, South Africa; Nairobi, Kenya; and Johannesburg, South Africa. Together the workshops attracted 147 participants from five African countries, as well as 21 unique U.S. companies and 41 total U.S. public and private participants. Each event showcased high-level technical content from both U.S. and African experts regarding electrical safety, solar mini-grid, and energy storage standards and conformity assessment in the African market, providing a valuable opportunity for U.S. and African participants to share best practices, develop relationships, and gain technical knowledge.

This Final Report provides a comprehensive overview of ANSI's implementation of the U.S. – Africa CESP. The report contains dedicated information on the outcomes of all workshops carried out during the 18-month base phase. It contains the following components: (i) workshop summaries, participant information, and final agendas, (ii) development impact assessments from the workshops, and (iii) complete public market reports. ANSI welcomes the opportunity to further discuss any aspect of this AAR with USTDA. A list of workshops completed during the base phase of the U.S. – Africa CESP is included below.

Overall, each workshop delivered a variety of benefits to participants, and in particular those from the U.S. private sector. These include sensitization to the Sub Saharan African energy environment, networking with potential commercial partners and key government decision makers, the opportunity to share U.S. and international best practices, as well as influence African policies and regulations to facilitate economic development and open up trade and investment opportunities with the U.S. Complete overviews of each workshop, as well as final agendas and related links, are included in the following sections.

Workshop 1 **"Electrical Safety for Clean Energy Systems Workshop"**
Location **Cape Town, South Africa**
Date **May 16, 2016**
Participants **14**

Workshop 2	**"Solar Mini-Grid Workshop: Regulatory Framework and Quality Assurance"**
Location	**Nairobi, Kenya**
Date	**September 29, 2016**
Participants	**85**

Workshop 3	**"U.S. – South Africa Workshop on Energy Storage Standards, Conformance and Technology"**
Location	**Johannesburg, South Africa**
Date	**February 28, 2017**
Participants	**48**

WORKSHOP #1: Electrical Safety

Workshop 1 **"Electrical Safety for Clean Energy Systems Workshop"**
Location **Cape Town, South Africa**
Date **May 16, 2016**
Participants **14**

EXECUTIVE SUMMARY

On May 16, 2016, the American National Standards Institute (ANSI), through the support of the U.S. Trade and Development Agency (USTDA) initiative the U.S.-Africa Clean Energy Standards Program (CESP), held the "Electrical Safety for Clean Energy Systems" workshop in Cape Town, South Africa. Highlights from the workshop include:

- Three countries were represented: the United States, South Africa and Nigeria;
- A wide range of public and private entities participated, including the U.S. company Itron and the South African Parliament;
- 100% of surveyed participants believe the workshop will contribute to the improvement of Africa's physical infrastructure;
- The workshop was one of three programs included in Power Africa Day, which exposed CESP workshop participants to information exchange on other relevant issues, including currency risk and energy project financing; and
- The workshop took place just ahead of the 2016 African Utility Week (AUW), which allowed participants to take advantage of the 250 exhibitors, 81 countries and 79 African utilities that participated in AUW.

WORKSHOP SUMMARY

The first CESP workshop focused on the fundamental issue of electrical safety, showcasing high-level technical content from the foremost U.S. experts on electrical safety standards. Presentations detailed the following topics: the National Electrical Safety Code, fundamentals of safe electrical installations in user facilities, emerging electrical codes, and safety practices for electricity in the home and workplace. The program received significant exposure through its involvement in Power Africa Day and co-location with Africa Utility Week. ANSI worked together with the National Electrical Manufacturers Association (NEMA) as its primary technical expert, as well as members of the IEEE National Electrical Safety Code (NESC) technical committee and Power Africa to organize the workshop.

The workshop was attended by 14 speakers and attendees from two Sub Saharan African countries: South Africa and Nigeria. Four U.S. companies attended the workshop including Comverge, Eversource Energy, Itron, and Parkson. Other important decision makers and stakeholders included: the Nigerian Energy Regulatory Commission, the South African Parliament and the South African Utility (Eskom). U.S.-Africa cooperation on electrical safety standards will provide opportunities for U.S. providers of electrical products and services to enter or expand in the African market, where the export opportunity is valued at USD 30 million annually.

Agenda

Electrical Safety for Clean Energy Systems Workshop

May 16, 2016
8:30 AM – 12:30 PM
Westin Hotel
Cape Town, South Africa

8:30 **Opening and Welcome**
Mr. Jacob Flewelling, U.S. Trade and Development Agency (USTDA)
Ms. Madeleine McDougall, American National Standards Institute (ANSI)

8:45 **Overview of this Workshop: Technical Principles and User Practices**
Mr. Gene Eckhart, National Electrical Manufacturers Association (NEMA)

9:00 **National Electrical Safety Code: An Installation Code for Utilities**
Mr. Lauren E. Gaunt, Eversource Energy
Mr. Mark A. Konz, Gulf Power Company

The National Electrical Safety Code, developed by the ANSI accredited C2 Committee, covers basic provisions for safeguarding persons from hazards arising from the installation, operation, or maintenance of (1) equipment in electric supply stations, and (2) overhead and underground electric supply and communication lines. It also includes work rules for the construction, maintenance, and operation of electric supply and communication lines and equipment. The standard is applicable to the systems and equipment operated by utilities, or similar systems and equipment, of an industrial establishment or complex under the control of qualified persons. This standard consists of the introduction, definitions, grounding rules, list of referenced and bibliographic documents.

9:45 **Fundamentals of Safe Electrical Installations in Users Facilities**
Mr. Gene Eckhart, NEMA

Years of experience have shown that a safe electrical system includes several technical requirements, including installation codes, product standards, certification, and verification of the installation. If any of these component parts are missing or incomplete the government authorities having jurisdiction over a particular project are not in position to issue a permit to use the facility, and in fact should not do so.

10:30 **Break**

10:45 **Emerging Electrical Codes for Renewable Energy Sources**
Mr. Mark A. Konz, Gulf Power Company

The widespread use of renewable sources of electricity on a commercial basis by electrical utilities, particularly photovoltaic (PV) and wind energy, which has increased significantly in recent years, has required the development of additional chapters or sections to existing installation codes to ensure that proven principles are applied on a

consistent basis to ensure that the installations are safe for both suppliers and users of electricity. Development of these additional chapters is an ongoing effort by several organizations and will likely require a few years to complete.

11:45 **Safety in Practice: Electricity in the workplace and the home**
Mr. Gene Eckhart, representing Electrical Safety Foundation International (ESFI)

Even when all the proper technical components for an electrical installation are met and approved, in practice, day to day safety is the responsibility of the persons using electrical energy. The safe use of electricity in the workplace, e.g., avoiding the hazards of arc flash, and the safe use of electricity in the home, particularly protecting children, requires education derived from lessons learned over decades of safe electrical use.

12:15 **Closing Summary**
Mr. Gene Eckhart/ANSI

WORKSHOP #2: Solar Mini-Grids

Workshop 2 **"Solar Mini-Grid Workshop: Regulatory Framework and Quality Assurance"**
Location **Nairobi, Kenya**
Date **September 29, 2016**
Participants **85**

EXECUTIVE SUMMARY

On September 29, 2016, the American National Standards Institute (ANSI), through the support of the U.S. Trade and Development Agency (USTDA) initiative the U.S.-Africa Clean Energy Standards Program (CESP), held the "Solar Mini-Grid Workshop: Regulatory Framework and Quality Assurance" workshop in Nairobi, Kenya.

Highlights from the workshop include:

- Twelve U.S. companies and four African countries were represented: Kenya, Liberia, South Africa, and Tanzania;
- 85 solar mini-grid experts, regulators, and implementers participated in the workshop;
- The workshop occurred at a critical moment as the Kenyan Energy Bill, 2015 awaited signature, providing participants an opportunity to engage Kenyan regulating authorities before the Bill's implementation; and
- The workshop was co-located and took place just ahead of the International Off-Grid Renewable Energy Conference & Exhibition (IOREC), which allowed participants to maximize opportunities for information-sharing and networking.

WORKSHOP SUMMARY

The second CESP workshop addressed three important topics pertaining to the solar mini-grid space: pricing and billing, quality assurance, and grid integration. ANSI worked with the Kenya Rural Electrification Authority (REA), Power Africa, the U.S. Department of Energy, and a variety of U.S. and Kenyan experts to organize relevant content and messages for the workshop.

The workshop was attended by 85 participants, including participants from four Sub Saharan African countries, 12 U.S. companies, three Kenyan government bodies, and a variety of African and international organizations. U.S. companies in attendance included: Babford & Company, EarthSpark International, Electrical Power Design, Fluidic Energy, MRIGlobal, NRECA International, PowerGen, PowerHive, Quaint Energy, Renewvia, Rockefeller Foundation, and SparkMeter. Key Kenyan government regulatory bodies and decision-makers that participated in the workshop include Kenya REA, Energy Regulatory Commission (ERC), and the Ministry of Energy and Petroleum.

The U.S. Department of Energy highlighted the timeliness of the workshop in addressing issues pertinent to both the Kenyan and East African off-grid space. The workshop occurred as the ERC was writing sector-specific regulations and addendums to the pending Draft National Energy Policy (2015) and Energy Bill (2015) and provided an opportunity for the U.S. private sector to gain clarity and direction from Kenyan regulators while sharing the challenges they face. The limitations of current regulatory policy demonstrate the need for clear, off-grid specific policies and the adoption of internationally-accepted codes and standards to permit Kenyan and East African markets to expand electrification by gaining full access to U.S. manufacturers and service providers. Following the workshop the ERC noted

the workshop allowed the regulator to understand “the expectations of the people (they) regulate and hope to incorporate (address) these concerns in future regulations.”

Since the workshop took place, the USAID mission in Uganda, the USTDA West Africa office, the Carnegie Mellon University Rwanda Campus and Babford & Company have all reached out to ANSI requesting to replicate the workshop in other regions of Africa.

Agenda

Solar Mini-Grid Workshop: Regulatory Framework and Quality Assurance

September 29, 2016
8:30 AM – 5:00 PM
Safari Park Hotel
Nairobi, Kenya

9:00 **Welcome and Opening remarks:**
Don Nay, Regional Senior Commercial Officer for Sub Saharan Africa, U.S. Embassy
Katrina Pielli, Power Africa
Madeleine McDougall, ANSI

9:20 **The State-of-play for Kenya's Solar Mini-Grid Market**
James Muriithi, Kenya Rural Electrification Authority (REA) (30 minutes)
Alberto Rodriguez, TTA (with Catherine Kola, ECA for Q&A) (30 minutes)
Q&A (5 minutes)

10:25 **Tea/coffee Break**

10:40 **Focus topic 1: "Pricing/Billing: Regulatory Framework for Fair and Consistent Billing"**
Sayan Chakraborti, MRI Global (30 minutes)
Leonard Yegon, Energy Regulatory Commission (ERC) (30 minutes)
Q&A (15 minutes)

11:55 **Lunch Break**

1:30 **Focus topic 2: "Quality Assurance and Technical Standards for Mini-Grids"**
Rose M. Mutiso, U.S. Department of Energy (10 min)
Ian Baring-Gould, NREL (30 min)
Andrew Mnzava , IFC Tanzania (15 min)
Jackson Mutonga, GIZ (15 min)
Daniel Schroth, AfDB (15 min)
Facilitated discussion featuring private sector perspectives from Pam Onyanyo of Renewvia and audience Q&A (30 min)

3:30 **Focus topic 3: "Grid Integration: Preparing for Future Grid Connection"**
Kiprotich Bii, ERC (20 minutes)
Aaron Cheng, PowerGen (20 minutes)
Carolina Barreto and Pepin Tchouate, Power Africa (20 minutes)
Naomi Gichuhi, Kenya Power and Lighting (20 minutes)
Q&A (15 minutes)

5:05 **Closing Remarks**
Rose M. Mutiso, U.S. Department of Energy (10 minutes)

WORKSHOP #3: Energy Storage

Workshop 3	**"U.S. – South Africa Workshop on Energy Storage Standards, Conformance and Technology"**
Location	**Johannesburg, South Africa**
Date	**February 28, 2017**
Participants	**48**

EXECUTIVE SUMMARY

On February 28, 2017, the American National Standards Institute (ANSI), through the support of the U.S. Trade and Development Agency (USTDA) initiative the U.S.-Africa Clean Energy Standards Program (CESP), held the "U.S. – South Africa Workshop on Energy Storage Standards, Conformance and Technology" in Johannesburg, South Africa.

Highlights from the workshop include:

- 7 U.S. private sector organizations were represented;
- 48 energy storage experts, regulators, and implementers participated in the workshop;
- 100% of surveyed participants believe the workshop will contribute to transparency and access to information regarding energy storage in South Africa;
- 96% of surveyed participants believe the workshop will contribute to the use of advanced technologies in South Africa; and
- The workshop occurred at a critical moment as the South African government is considering ways to promote energy storage systems. In particular, South Africa's Industrial Development Corporation (IDC) is looking for ways to expand energy storage investment, and the South African Bureau of Standards (SABS) is in the process of developing standards for energy storage systems.

WORKSHOP SUMMARY

The third CESP workshop covered standards–related aspects of energy storage to facilitate greater proliferation of safe energy storage technologies into the African market to support residential micro-grid and grid-connected systems. ANSI collaborated with the Industrial Development Corporation (IDC), the South African Bureau of Standards (SABS), and a variety of U.S. experts to develop relevant content and presentations

The workshop was attended by 48 participants from the U.S. and South Africa. Seven U.S. companies and five South African government bodies participated in the workshop. American organizations included Air Products, Comverge, Eaton, Fluidic Energy, National Electrical Manufacturers Association (NEMA), National Fire Protection Association (NFPA), and Underwriters Laboratory (UL).

This workshop occurred at an opportune time as the South African government is considering methods for promoting energy storage systems, the IDC is looking for ways to expand energy storage investment, and SABS is in the process of developing standards for energy storage systems. This open forum helped to sensitize South African regulators and standards developers to the range of available standards and conformance solutions developed by U.S.-based standards developers available to meet South Africa's needs.

Multiple South African stakeholders involved in policy development lauded the energy storage workshop for its relevance and utility as South Africa considers and develops energy storage standards. These organizations included the national utility (Eskom), Department of Trade and Industry, SABS, the Department of Science and Technology, and the Council for Scientific and Industrial Research (CSIR). In particular, CSIR, a research organization that plays a key role supporting government programs, stated that it plans to "incorporate some of the lessons learnt in standards development procedures."

Following the workshop, ANSI was successful at securing a meeting between NEMA, NFPA and UL and SABS to enhance the relationship between their organizations and discuss specific opportunities for cooperation in the development or adoption of standards in the energy storage space. Particularly, SABS and UL discussed opportunities for technical guidance and collaboration, execution of a recently signed UL-SABS memorandum of understanding on safety education, and the possibility of collaborating on an Energy Storage Safety Summit UL is organizing in South Africa.

Agenda

U.S. – South Africa Workshop on Energy Storage Standards, Conformance, and Technology
February 28, 2017
9:00 AM –5:15 PM
Main Station Room 1 & 2
Radisson Blu Gautrain, Johannesburg, South Africa

9:00 **Welcome and Opening remarks:**
Jacob Flewelling, USTDA
Madeleine McDougall, ANSI

9:20 **The State-of-play in South Africa**
Bertie Strydom, IDC
Overview of the South Africa energy storage activities (30 minutes)
Thato Chabeli, SABS
Energy Storage Standards Roadmap (20 minutes)
Dr. Nico Rust, UYilo Programme
An Accredited Laboratory's view on the Implementation of Standards, their Complexity and Relevance to the South African Energy Storage Landscape (20 minutes)
Q&A (15 minutes)

10:45 **Tea/coffee Break**

11:00 **Overview and expectations for energy storage technologies**
Rich Bielen, NFPA
Fire and safety considerations (20 minutes)
Dr. Judy Jeevarajan, Underwriters Laboratory (UL)
Current research, scientific developments of interest, etc. (20 minutes)
Steve Griffith, NEMA (20 minutes)
Q&A (15 minutes)

12:15 **Lunch Break**

1:30 **Status report on standards for energy storage**
Ken Boyce, UL
UL 9540 overview (30 minutes)
Steve Griffith, NEMA
IEC TC120 (Electrical Energy Storage Systems) Committee (30 minutes)
Q&A (15 minutes)

2:45 **Testing and conformity assessment for energy storage**
Ken Boyce, UL and Steve Griffith, NEMA:
Promoting safe products
Keeping low quality products out of the RSA/SSA market
U.S. DOE compliance checklist and permitting guidance
U.S. DOE protocol on system performance
Q&A (15 minutes)

4:00 **Tea/coffee Break**

4:15 **Panel: Next steps for development and implementation in South Africa**
Ken Boyce, UL
Steve Griffith, NEMA
Rich Bielen, NFPA
Thato Chabeli, SABS
Bertie Strydom, IDC
Dr. Nico Rust, UYilo Programme

5:00 **Closing Remarks**

Relevant links

Links to flyers, photos, final agendas and presentations from all three workshops are available on the U.S.-Africa CESP web site: www.StandardsPortal.org/us-africacesp

DEVELOPMENT IMPACT ASSESSMENT

The U.S.-Africa CESP is intended to provide an open platform for the sharing of important commercial and industrial standards information and practices with government officials and industry in sub-Saharan Africa (SSA) to ensure that decision makers who implement standards, testing protocols, and regulatory procedures for the energy sector are informed of internationally accepted industry-led standards. During the base phase of implementation, feedback from participating U.S. and African organizations provided a clear indication of the program's success. Examples of positive workshop outcomes are included below:

- Policy Influence. Two of the three CESP workshops occurred while regulatory bodies in the host country were considering policy adoption or amendments. The timing of these workshops presented a valuable opportunity for U.S. business to interact with officials in the host country to discuss various methods of regulation of the energy sector. Lauding this benefit, one U.S. organization stated that the workshop helped improve "Policy influence (and) technical cooperation with the government and operators." These outcomes would lead to "more investment once rules (for) operations are addressed;"
- Networking Opportunities. Many U.S. and Sub Saharan African countries listed networking opportunities as a benefit of the workshops. One U.S. organization stated, "As a result of my presentation at the workshop, many East African companies have approached us to explore if (our organization) would like to partner with them;"
- Promoting U.S. Products and Technology. The workshops provided the opportunity for U.S. companies to sensitize African companies and government officials to U.S. standards and products. For example, a Kenya-based renewable energy provider and mini-grid operator, cited interest in "follow-up with American organizations for the access (to) technology and best practices in technology implementation" as an outcome of the workshop;
- Building and Expanding Relationships. Following one workshop a U.S. organization stated that "They (the host country) recognize it is not practical or efficient to develop new standards if there are standards that can be referenced or used, that might be a better option than to develop new standards;"
- Promoting Quality Standards, Conformity Assessment, and Technical Regulations. Multiple workshop participants emphasized the role of CESP workshops in increasing the quality of standards in Africa. In particular, a South Africa-based company, stated that the CESP workshop would contribute to the development of more robust standards and regulations in Africa and would help "protect millions of people across Africa on a continuous basis from getting seriously hurt by electricity;"
- Awareness Building. U.S. organizations emphasized that the workshops helped build awareness of U.S. standards and the U.S. standards system. One such organization stated, "The meeting provided (the host nation) a better understanding of how the various SDOs work together and to help differentiate safety standards, from product standards, from industry standards. We also were able

to educate them on the processes of how the different SDOs develop standards and how they eventually get adopted and referenced by the regulators;"

- Promoting Transparency. Following each of the three workshops participants underscored the opportunity to engage with government officials and regulators to increase the transparency of the regulatory process. One a government regulator confirmed that the workshop provided "the expectations of the people (they) regulate and hope to incorporate (address) these concerns in future regulations";
- Mutual Exchange (Africa to U.S.). Multiple U.S. organizations highlighted that the workshops allotted a valuable opportunity to learn more about the physical and regulatory environment in the host countries. A U.S. organization said, "The Workshop also helped us understand the South African market. This includes the different use cases being contemplated, the local energy ecosystem, and the unique needs for the country and its people. For example, there was quite a bit of insight into the electric utility structure, dynamics and demands."
- Mutual Exchange (U.S. to Africa). Multiple African organizations highlighted the opportunity to learn more about U.S. standards and the U.S. standards system. One African organization indicated that following the workshop the organization plans to "incorporate some of the lessons learnt in standards development procedures."

Public Market Report:
Electrical Safety for Clean Energy Systems Workshop

The U.S.-Africa Clean Energy Standards Program is sponsored by the U.S. Trade and Development Agency and coordinated by the American National Standards Institute in partnership with Power Africa.

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PUBLIC MARKET REPORT

Electrical Safety for Clean Energy Systems Workshop

May 16, 2016
8:30 AM – 12:30 PM
Westin Hotel
Cape Town, South Africa

WORKSHOP SUMMARY

On May 16, 2016, the American National Standards Institute (ANSI), through the support of the U.S. Trade and Development Agency (USTDA) initiative the U.S.-Africa Clean Energy Standards Program (CESP), held the "Electrical Safety for Clean Energy Systems" workshop in Cape Town, South Africa. As the first workshop under the CESP, the focus was on the fundamental issue of electrical safety. Increased access to reliable electricity sources is among the top priorities of many sub-Sahara African countries, but safety has emerged as a key concern. In this context, ANSI worked together with the National Electrical Manufacturers Association (NEMA) as its primary technical expert, as well as members of the IEEE National Electrical Safety Code (NESC) committee and Power Africa to organize relevant content and messages.

The workshop emphasized the importance of a robust quality infrastructure to ensuring the safe generation, distribution, transmission, management and use of electricity across the continent. Speakers also emphasized that, over the last 50 years, the United States has led the way in developing a globally relevant, interlocking system of electrical safety installation codes, product standards, testing and verification processes that are available for African countries to adopt and use without having to go through the same trial and error process. U.S.-Africa cooperation on these standards will also provide opportunities for U.S. providers of electrical products and services to enter or expand in the African market, where the export opportunity was valued at approximately USD 119 million in 2015.

Electrical safety depends on two key parts: technical and safe practices. From a technical standpoint, a safe electrical system requires a rigorous installation code, products that are designed and manufactured to world-class standards, testing and certification system to assure the user that the products in fact meet the standards to which they are manufactured, and overall system inspection from knowledgeable experts. Regarding safe practices, users of electricity need to be aware that their own actions can impact their own safety, in nearly all environments including industrial and commercial workplaces as well as the residential community. These safe practices have been developed over years of experience by users worldwide, and have been collected and organized to present them to users in all communities, from children to adults.

The electrical infrastructure of the electrical utilities in the United States follows the *National Electrical Safety Code*, an American National Standard developed and published by the Institute of Electric and Electronic Engineers. This code is updated and published on a five-year cycle; the latest edition is scheduled to be published in September of this year. This was the basis for the initial presentation that targeted the electrical utilities and their regulators.

The electrical infrastructure of users of electricity in the United States is based on the *National Electrical Code*®, an American National Standard published by the National Fire Protection Association. The code

is updated and published on a three-year cycle, the next edition of which will be published in September of this year.

Electrical products used in installations are designed and manufactured to standards developed and published by several different standards development organizations in the United States, all of whom are accredited by ANSI. Additionally, these products are tested and certified by independent third parties to ensure that the products conform to the required standards.

Inspection and verification has been shown to be necessary to complete the loop to ensure a safe electrical system. This step is conducted by technical experts who are licensed on a state-by-state basis, and includes review and approval of installation planning documents as well as an on-site inspection of the installation prior to issuance of an occupancy permit by the local government authority.

Electric installation codes used by suppliers (utilities) and their customers are now starting to include requirements that address the unique features of clean energy systems, such as wind power and solar photo-voltaic (PV), energy storage, and distributed energy systems such as microgrids.

Across all the presentations several themes consistently emerged:

- Codes and standards are developed by accredited organizations via documented voluntary consensus processes.
- Safety codes and standards are intended to provide practical methods of safeguarding persons and property and are based on many years of practical experience.
- Safety codes and standards are adopted by various regulatory and governmental agencies.
- Development is ongoing and revisions are made on regular cycles to ensure that the codes are relevant and up-to-date. A good example is the inclusion of clean energy components that are increasingly being added to installation codes, as well as the development of new product standards as needed.
- Participation in the development of codes and standards is open to all stakeholders on a global basis. Indeed, it is encouraged by the respective technical committees.
- Codes and standards developed by U.S.-based organizations, including the National Electrical Safety Code, can be adopted, or more likely adapted, to meet the needs of other countries. In 2015, IEEE worked with Pakistan Engineering Council, through the support of USAID, to develop the Pakistan Electrical and Telecommunication Safety Code, based in part on the NESC.
- Information is available to all stakeholders in a transparent manner primarily via the internet at little or no cost.
- There are no shortcuts to achieving safe electrical systems by bypassing the necessary component parts.

Links to a flyer, photos, the final agenda and presentations from the workshop are available for on the U.S.-Africa CESP web site: www.StandardsPortal.org/us-africacesp

MARKET OPPORTUNITY

- Based on the trade data included below, South Africa, Angola, Nigeria, Ghana and Cameroon are top 5 export destinations for U.S. electrical products.
- Key challenges for related U.S. companies looking to enter or expand in these markets include finding and working with reputable product distributors, freight forwarders, project contractors and local utilities, many of whom are government-owned.
- A number of resources exist to learn more about the markets and related opportunities, including Notify U.S., which offers U.S. entities an opportunity to review and comment on proposed foreign technical regulations that can affect their businesses and their access to

international markets. Various U.S. government agencies, including USTDA, USAID, the U.S. Commercial Service, and initiatives such as Power Africa, also have valuable market intelligence and engagement vehicles for U.S. companies to take advantage of.

With the adoption of internationally-accepted codes and standards, markets in Africa will expand significantly to U.S. manufacturers and service providers. For these U.S. companies, the primary customers should be electrical generation, transmission, and distribution utilities located across Africa. As those utilities and national governments continue to plan and deploy electrical systems, including to transmit electricity across borders and to connect millions of households and businesses to sources of electricity, safety is paramount. Additional customers include firms involved in engineering, procurement and construction of electric power facility infrastructure in the region. As described below, the export of relevant U.S. products to African countries eligible under the African Growth and Opportunity Act (AGOA) were valued at USD 119 million in 2015.

The range of electrical products needed for safe and reliable transmission, distribution and use of electrical energy is extensive. Years of experience has shown that at the least the following list of products is included:

HTS number	***Product description***
7306.30	Non-insulated metallic conduit
7326.9085	Rods for electrical grounding
8501.61	AC generators (alternators): Of an output not exceeding 75 KVA
8501.62	AC generators (alternators): Of an output exceeding 75 kVA but not exceeding 375 kVA
8501.63	AC generators (alternators): Of an output exceeding 375 kVA but not exceeding 750 kVA
8501.64	AC generators (alternators): Of an output exceeding 750 kVA
8503.00	Commutators: Stators and rotors for motors and generators
8504.21	Liquid dielectric transformers: Having a power handling capacity not exceeding 650 kVA
8504.22	Liquid dielectric transformers: Having a power handling capacity exceeding 650 kVA but not exceeding 10,000 kVA
8504.23	Liquid dielectric transformers: Having a power handling capacity exceeding 10,000 kVA
8504.31	Other transformers: Having a power handling capacity not exceeding 1kVA
8504.32	Other transformers: Having a power handling capacity exceeding 1 kVA but not exceeding 16 kVA
8504.33	Other transformers: Having a power handling capacity exceeding 16 kVA but not exceeding 500 kVA
8504.34	Other transformers: Having a power handling capacity exceeding 500 kVA
8504.40	Static converters
8504.50	Other inductors
8504.90	Parts
8532.10	Fixed capacitors used in 50/60 Hz circuits, w/reactive power capacity of not < .5 kvar
8535.10	Electrical apparatus for switching or protecting electrical circuits, voltage > 1,000 V: Fuses for a voltage > 1,000 V
8535.21	Automatic circuit breakers for a voltage > 1kV but < 72.5 kV
8535.29	Other circuit breakers for a voltage > 72.5 kV
8535.30	Isolating switches and make-and-break switches
8535.40	Lightning arresters, voltage limiters and surge suppressors
8535.90	Other electrical apparatus for switching or protecting electrical circuits above 1000 V

8536.10	Fuses
8536.20	Automatic circuit breakers
8536.30	Other apparatus for protecting electrical circuits
8536.41	Relays, for a voltage not > 60 v
8536.49	Relays, 60 to 1000 V
8536.50	Switches
8536.61	Lamp holders
8536.69	Electrical connectors
8536.90	Boxes, raceway, terminals and others
8537.10	Panel boards, voltage not > 1,000 V
8537.20	Switchgear and assemblies for a voltage > 1,000 V
8538.10	Boards, Panels, consoles, desks, etc. for goods of 8537 w/out their apparatus
8538.90	Molded and other parts for 8536 and 8537
8544.41	Electric conductors, fitted with connectors for voltage not > 80 V
8544.49	Electric conductors, fitted with connectors for voltage not > 80 V:
	Other, without connectors
8544.51	Electric conductors, fitted with connectors, voltage > 80 V but < 1,000 V
8544.59	Electric conductors, fitted with connectors, voltage > 80 V but < 1,000 V:
	Other, without connectors, of copper
	Other, not of copper
8544.60	Electric conductors, fitted with connectors, voltage > 1,000 V
	Not fitted with connectors and of copper
	Not fitted with connectors and not of copper
8544.70	Optical fiber cables
8546.10	Electrical insulators of glass
8546.20	Electrical insulators of ceramics
8546.90	Electrical insulators of other material
8547.90	Insulated metallic conduit
9028.30	Electricity meters
9028.90	Parts and accessories

The U.S. International Trade Commission Interactive Tariff and Trade DataWeb provides direct access to trade data and allows users to create customized reports from queries created under "advanced searching" from a defined list of products. Using the list above a query was developed to determine the export of these products to countries in sub-Sahara Africa using the AGOA 2016 defined list of countries. The table below shows the result of exports over the past three years to the top 25 AGOA eligible countries. These data represent all of the products from the list above aggregated. It is possible to disaggregate the data into specific tariff lines if necessary for further analysis.

U.S. Exports of Electrical Products to AGOA Countries

Annual + Year-To-Date Data from Jan - Apr

Country	2014	2015	2015 YTD	2016 YTD	Percent Change YTD2015 - YTD2016
		In 1,000 Dollars			
South Africa	103,722	95,818	30,711	33,190	8.10%
Nigeria	75,961	60,027	22,836	18,174	-20.40%
Angola	95,477	44,790	17,699	25,123	41.90%
Ghana	14,734	33,981	13,660	16,775	22.80%
Cameroon	22,430	22,437	11,023	2,904	-73.70%
Congo (ROC)	19,590	9,644	3,720	1,206	-67.60%
Gabon	13,692	8,869	3,767	1,561	-58.60%
Djibouti	4,532	7,803	2,319	908	-60.80%
Chad	5,948	6,949	1,796	527	-70.60%
Cote d`Ivoire	2,579	6,013	2,125	364	-82.90%
Liberia	2,111	5,125	129	2,593	1909.80%
Mauritania	4,368	4,216	1,465	1,542	5.30%
Kenya	3,149	3,660	801	3,137	291.60%
Ethiopia	17,893	3,562	1,447	1,781	23.10%
Senegal	5,679	3,076	931	382	-58.90%
Mozambique	1,998	2,595	1,064	532	-50.00%
Namibia	3,364	1,752	1,213	362	-70.20%
Niger	663	1,418	896	29	-96.70%
Tanzania	8,001	1,173	390	523	34.10%
Botswana	484	1,045	138	205	47.80%
Mali	406	851	152	1,514	897.90%
Uganda	879	835	247	428	73.40%
Zambia	3,059	669	176	150	-14.90%
Guinea	275	442	117	32	-72.90%
Sierra Leone	756	322	30	65	119.00%
Subtotal : top 25	411,749	327,071	118,852	114,008	-4.10%
All Other countries:	3,317	1,121	477	3,539	642.50%
Total	**415,066**	**328,192**	**119,329**	**117,547**	**-1.50%**

Sources: Data on this site have been compiled from tariff and trade data from the U.S. Department of Commerce and the U.S. International Trade Commission.

Public Market Report:
Solar Mini-Grid Workshop: Regulatory Framework and Quality Assurance

Phase I Workshop No. 2 USTDA Activity No. (2015-11008A) and Contract No. (CO201511061)

Produced through cooperation between
the **American National Standards Institute (ANSI)** and **Power Africa**
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October 2016

PUBLIC

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The U.S. Trade and Development Agency

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PUBLIC MARKET REPORT

Solar Mini-Grid Workshop: Regulatory Framework and Quality Assurance

September 29, 2016
8:30 AM – 5:00 PM
Safari Park Hotel
Nairobi, Kenya

BACKGROUND

Solar mini-grids have long served as an efficient means of electrifying rural areas in developing countries. In sub-Saharan Africa, more than 600 million people lack access to electricity, the majority of whom live in rural areas that will not gain access to national power grids in the foreseeable future. Energy deficiencies are particularly profound in East Africa, where less than 22 percent of the population had access to electricity in 2015 compared with the 33.5 percent SSA average.[1] To address this energy deficiency, Kenya has set an ambitious goal of nationwide electricity access by 2030.

For Kenyan populations residing in remote locations with rugged topography, solar mini-grids provide a practical alternative. Renewable energy mini-grids are less dependent on large-scale infrastructure and can be placed in service more quickly and economically than the national grid. For these reasons, energy experts estimate nearly one-quarter of Kenya's population will be best served by mini-grids in the near to medium term.[2]

Recognizing that the private sector will play an essential role in electrifying rural communities, Kenya has begun to create a more investment-friendly environment for renewable energy. This focus has helped the Kenyan energy sector become one of the most active in Africa. In 2015 alone, Kenya received $4 billion in renewable energy investments, the second most in Africa.

As investment in off-grid energy expands, the policy environment becomes a critical factor for solar mini-grid implementers and suppliers. Stakeholder engagement in the policy-making process and the establishment of clear rules for the off-grid sector by African governments is essential to ensure U.S. companies are included in the market. Policy conducive to private utility providers will also help to facilitate quality, off-grid energy access throughout Africa.

WORKSHOP SUMMARY

In this context, the American National Standards Institute (ANSI), through the support of the U.S. Trade and Development Agency (USTDA) initiative the U.S.-Africa Clean Energy Standards Program (CESP), held the "Solar Mini-Grid Workshop: Regulatory Framework and Quality Assurance" in Nairobi, Kenya on September 29, 2016. The workshop addressed three important topics pertaining to the solar mini-grid space: pricing and billing, quality assurance, and grid integration.

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[1] UNIDO. (2016). "2016 East African Community Renewable Energy and Energy Efficiency Regional Status Report."
[2] ESMAP. (May, 2016). Upscaling Mini Grids for Least Cost and Timely Access to Electricity Services." Retrieved from https://www.esmap.org/sites/esmap.org/files/DocumentLibrary/9515-ESMAP_Mini%20Grids%20Progam%20Booklet_Web.pdf

The solar mini-grid workshop featured presentations by U.S. and Kenyan experts from both the public and private sectors. Presentations focused on key aspects of solar mini-grid system development with the objective of fostering discussions among U.S. and Kenyan experts regarding regulatory challenges and opportunities in the Kenyan market as well as crosscutting issues affecting other East African markets and beyond.

Seventeen speakers discussed varying aspects of the African solar off-grid standards and regulation. Three U.S. private sector speakers from MRIGlobal, PowerGen, and Renewvia provided expertise from field experience, while the remaining 14 speakers were composed of a variety of African, U.S., and international mini-grid experts including the Kenya Power and Lighting and the Energy Regulatory Commission (ERC).

Due to considerable support and suggestions from the U.S. Department of Energy, Power Africa, and the U.S. company, PowerGen, three European speakers were included in the workshop agenda. These organizations included: Economic Consulting Associates (ECA), GIZ, and Trama TechnoAmbiental (TTA). Together these three organizations added unique experience and value to the workshop agenda. In particular, ECA and TTA recently released a report analyzing the regulatory environment for renewable energy mini-grids in East Africa.

The workshop was attended by 85 participants from eight countries: Germany, Italy, Kenya, Liberia, South Africa, Spain, Tanzania, and the United States. Attendees included twelve U.S. companies, such as PowerHive and Electrical Power Design, and multiple foreign government officials from the Kenya Ministry of Energy and Petroleum and the Liberian Rural Renewable Energy Agency.

Links to a flyer, photos, the final agenda and presentations from the workshop are available for on the U.S.-Africa CESP web site: www.StandardsPortal.org/us-africacesp

MARKET OPPORTUNITY

Worldwide, an estimated 25 million households rely on off-grid solar as their primary or secondary energy source. By 2020, this number is expected to increase to 99 million. During this period, the retail value of the off-grid solar market is projected to grow to approximately $3.1 billion with the highest market potential in sub Saharan Africa (SSA).[3] Among SSA regions, East Africa is expected to emerge as a highly lucrative market for off-grid solar products due to low electrification rates, rising government intervention, and expanding product awareness among consumers.

Only 33.5 percent of the SSA population has access to electricity, with the majority living in rural areas that will not gain access to the national grid in the foreseeable future. Energy deficiencies are even greater in East Africa, where less than 22 percent of the population had access to electricity in 2015.[4] To address energy gaps, East African governments are shifting away from public ownership and management of energy distribution, generation, and transmission to meet the energy needs of rural communities. For example, in 2014, PowerHive became the first company to receive a utility concession from the Kenyan ERC to construct and operate 100 PV solar mini-grids across western Kenya.

[3] Lighting Global (February, 2016). "Off-Grid Solar Market Trends Report 2016." Retrieved from https://www.lightingglobal.org/launch-of-off-grid-solar-market-trends-report-2016/

[4] UNIDO. (2016). "2016 East African Community Renewable Energy and Energy Efficiency Regional Status Report."

Kenya has begun to incentivize private sector investment by removing its VAT tax on all solar products, implementing Feed-in-Tariffs, and developing a National Electrification Strategy. The nation's emphasis on renewables has made the Kenyan energy sector among the most active in Africa. In 2015 alone, Kenya received $4 billion in renewable energy investments, the second most in Africa. Further, Kenya ranks second for clean energy investment on the continent and is the world's 8th largest producer of geothermal energy.

Kenya has high potential for solar power generation receiving high daily insolation rates and more than 30 percent of Kenya's off-grid population already uses solar PV installations.[5] According to Transparency Market Research, the value of the off-grid solar lighting market in Kenya was more than $85 million in 2015.[6] Due to the growing government focus on renewable energies, more affordable pricing, and increased consumer awareness this market is likely to expand rapidly in the coming years. Transparency Market Research estimates that, by 2024, the addressable off-grid solar market in Africa will include 44 million households with a retail value of $2.12 billion.[7] However, while there is vast market potential, uncertainty surrounding the long term strategy for off-grid applications and consumer pricing expectations has slowed growth in the Kenyan solar energy sector.

The Kenyan Energy Regulatory Commission is in the process of adding clarity to the off-grid sector by writing sector-specific regulations and addendums. The pending Draft National Energy Policy (2015) and Energy Bill (2015) include provisions supporting the development of mini-grids; however neither explicitly defines mini-grids nor their expected role in national electrification strategies. These policies also create an implicit limitation on mini-grids to electrify isolated, off-grid areas where the most practical mini-grids could be either grid connected or serve as intermediaries to fast track electrification of areas to prepare for future grid connection. The limitations of current regulatory policy demonstrate the need for clear, off-grid specific policies and the adoption of internationally-accepted codes and standards to permit Kenyan and East African markets to expand electrification by gaining full access to U.S. manufacturers and service providers.

[5] Laurea (2009). "Kenya's Renewable Energy at a Glance." Retrieved from https://www.laurea.fi/en/document/Documents/Kenya%20Fact%20Sheet.pdf

[6] Transparency Market Research. (May, 2016). "Off-Grid Solar Lighting Market by Type and Geography - Global Industry Analysis, Size, Share, Growth Trends, and Forecast 2016 – 2024." Retrieved from http://www.prnewswire.com/news-releases/off-grid-solar-lighting-market-by-type--solar-home-systems--and-large-solar-home-systems--and-geography---global-industry-analysis-size-share-growth-trends-and-forecast-2016---2024-300289608.html

[7] Ibid

After Action Report:

U.S. – South Africa Workshop on Energy Storage Standards, Conformance and Technology

Phase I Workshop No. 3 USTDA Activity No. (2015-11008A) and Contract No. (CO201511061)

Produced through cooperation between
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February 2017

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PUBLIC MARKET REPORT

U.S.-South Africa Workshop on Energy Storage Standards, Conformance and Technology
February 28, 2017
9:00 AM –5:15 PM
Radisson Blu Gautrain,
Johannesburg, South Africa

BACKGROUND

Energy is an essential component of a functional economy. To date, no nation has developed its economy without abundant and affordable access to energy. This fact underscores the importance of mitigating energy shortages in the developing world. Currently sub-Saharan Africa (SSA), with a population of roughly one billion people, generates approximately the same amount of power as South Korea, with a population of 50 million.[1] Recognizing the limitations of low energy access, SSA nations have begun expanding energy capacity through the development of renewable sources.

South Africa has emerged as a continental leader for energy generation and investment. With more than 44 gigawatts (GW) of installed energy capacity, South Africa is nearly energy self-sustaining and accounts for roughly half of the total installed energy capacity in SSA.[2] However, the country is heavily reliant on coal-powered energy, which makes up approximately 77% of the nation's energy production. This dependence renders South Africa one of the world's largest greenhouse gas emitters and has compelled the nation to seek renewable energy solutions.

In 2011, the government of South Africa committed to increase the share of renewable energy sources in the national energy mix from approximately 5 percent to 30 percent by 2025.[3] The nation's lofty goals have helped South Africa become the African leader for renewable energy investment. In 2015 alone, South Africa received more than $4.5 billion.[4] While public and private investments have expanded available energy capacity, South Africa continues to struggle to meet growing electricity demands. Further the utility of renewable energy sources is limited by their intermittent energy generation that provides power when renewable sources are available rather than when energy is needed.

Energy Storage Systems (ESS) provide a solution to both inconsistent energy flows and thereby help to expand energy generation. Storage systems can augment electricity supplies by increasing the viability and affordability of renewable energies by balancing power supplies and preventing overloads and blackouts. Due to the complementary relationship between ESS and renewable energy development, increases in renewable energy investment and production will be met by similar increases in the market for ESS. As South Africa transitions away from fossil fuels, this relationship will establish ESS as central features of the electricity infrastructure.

WORKSHOP SUMMARY

In this context, the American National Standards Institute (ANSI), through the support of the U.S. Trade and Development Agency (USTDA) initiative the U.S.-Africa Clean Energy Standards Program (CESP), held

[1] World Bank Group. (2016). Independent Power Projects in Sub-Saharan Africa: Lessons from Five Key Countries."
[2] World Bank Group. (2016). Independent Power Projects in Sub-Saharan Africa: Lessons from Five Key Countries.
[3] South Africa Department of Energy. (2012). Strategic Plan 2011-2016. Retrieved from http://www.energy.gov.za/files/aboutus/DoE%20Strategic%20plan%202011_12%20-%202015_16.pdf
[4] UN Environmental Programme (UNEP). (2016). Global Trends in Renewable Energy Investment 2016. Retrieved from http://fs-unep-centre.org/sites/default/files/publications/globaltrendsinrenewableenergyinvestment2016lowres_0.pdf

the "U.S. – South Africa Workshop on Energy Storage Standards, Conformance and Technology" in Johannesburg, South Africa on February 28, 2017.

The workshop featured presentations by U.S. and South African experts from both the public and private sectors. Presentations focused on key aspects of energy storage system development with the objective of fostering discussions among U.S. and South African experts regarding regulatory challenges and opportunities in the South African market.

Seven speakers discussed varying aspects of the South African energy storage environment. Four U.S. private sector speakers from the National Electrical Manufacturers Association (NEMA), National Fire Protection Association (NFPA), and two speakers from Underwriters Laboratory (UL) provided presentations on standards and conformance practices for energy storage systems as well as developments in energy storage technology. Three South African speakers, the Industrial Development Corporation (IDC), South African Bureau of Standards (SABS), and UYilo Programme, provided background on the state of the energy storage market, as well as related standards and conformance in South Africa.

The workshop was attended by 48 participants. Attendees included seven U.S. companies, such as Comverge and Fluidic Energy, as well as multiple South African government officials from the Department of Trade and Industry, the Department of Energy, and the national utility Eskom.

Links to a flyer, photos, the final agenda and presentations from the workshop are available for on the U.S.-Africa CESP web site: www.StandardsPortal.org/us-africacesp

MARKET OPPORTUNITY

Among African nations, South Africa has emerged as a leader in renewable energy investment. Renewable-focused policies that attempt to shift national energy production away from predominately coal-powered energy will continue to galvanize energy investment. In support of these policies, South Africa has also committed to adding 13 GW of renewable electricity generation capacity by 2025.[5] However, energy expansion has not kept pace with growing electricity demands, requiring South Africa to amplify its generation capacity. As South Africa expands renewable capacity to meet energy shortfalls, ESS will become an essential component of the energy infrastructure.

To diversify its energy mix and meet growing consumer demand, South Africa is encouraging renewable investment through private sector-friendly policies. These policies include both renewable energy feed-in-tariffs (REFIT) and private sector bidding for energy projects. As of January 2017, the South African government has approved 92 Independent Power Producer (IPP) contracts for wind and solar PV generation with a total generation capacity of 6.3GW.[6]

The ongoing expansion of renewable generation in South Africa will make storage systems critical components of the energy infrastructure. This is because renewables, such as wind and solar, provide intermittent outputs, which must be either balanced by non-renewable sources or storage systems that help to level energy flows. ESS provide the ability to harness the intermittent nature of renewable sources by balancing ebbs and flows in the energy supply from intermittent renewable sources. These systems allow power providers to more effectively manage peaks and valleys from inconsistent energy inputs to match variations in consumer demand.

[5] USAID (July 2016). "Assessing South Africa's Energy Storage Market." Retrieved from https://www.usaid.gov/power-africa/newsletter/june2016/assessing-south-africas-energy-storage-market

[6] Department of Energy, Republic of South Africa. (September, 2015). State of Renewable Energy in South Africa. . Retrieved from http://www.gov.za/sites/www.gov.za/files/State%20of%20Renewable%20Energy%20in%20South%20Africa_s.pdf

Effective and safe ESS must be built on a firm foundation of installation codes, standards, and conformity assessment. These elements also allow storage systems to work efficiently across on- and off-grid systems. As South African utilities, IPPs, and residential property owners deploy ESS to complement renewable generation, relevant authorities will require an understanding of these emerging technologies to ensure safe and reliable energy. U.S. perspectives and experience deploying storage systems will benefit South African organizations as they seek to uptake of ESS.

The adoption of a U.S.-style safety system in South Africa would set a foundation to ensure safe and dependable energy access while creating consistency in expectations that will decrease market uncertainties. This would also provide a commercial advantage to related U.S. equipment manufacturers and service providers, since such components need to be aligned with the underlying codes and standards to form a total safety system. According to NEMA, when considering the size of South Africa's economy and current estimates of the global market demand for energy storage systems, the addressable market in South Africa can be estimated to be approximately $130 million.