U.S.-AFRICA CLEAN ENERGY STANDARDS PROGRAM

# Public Market Report:
# Energy Storage Standards, Conformance and Technology

Phase II Workshop No. 1 USTDA Activity No. (2015-11008A) and Contract No. (CO201511061)

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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.

# PUBLIC MARKET REPORT

**Energy Storage Standards, Conformance and Technology**

**May 24-25, 2018**
**9:00 AM – 5:00 PM**
**Safari Park Hotel**
**Nairobi, Kenya**

## BACKGROUND

In September 2017, the United States Trade and Development Agency (USTDA) hosted a reverse trade mission covering Kenyan Solar and Energy Storage Technologies. Following the RTM, the government of Kenya expressed its intention to develop a national energy storage strategy to increase the incorporation of renewable sources to the main grid and to augment uptake of quality energy storage technologies.

Energy storage systems are emerging as central features of electrical infrastructure as global economies transition away from fossil fuels and toward renewable energy systems. Storage systems are an essential tool for decentralized energy systems of all sizes. They play a critical role when integrated in a system-relevant and cost-effective manner. If deployed effectively, energy storage can make the delivery of off-grid energy a reliable and cost-effective option for millions across Kenya. In addition, if integrated into Kenyan electricity grids, energy storage can help integrate more renewable energy into its grid supply, improve the reliability of the current electrical supply, and defer significant investments into new transmission and distribution capacity.

As of 2017, Kenya had an installed generation capacity of approximately 2.34 gigawatts (GW) of electricity with on-grid capacity across 42 plants, plus an additional 11.5 MW in 19 off-grid stations in remote parts of the country. Of this installed capacity, around 30% is owned and operated by Independent Power Producers (IPPs), while the remaining 70% capacity is owned and operated by KenGen.[1] The Ministry of Energy (MOE) anticipates peak electricity demand will exceed 15 GW by 2031, and the national development strategy, Vision 2030, aims to meet that need through the expansion and diversification of the country's renewable energy generation capacity. Kenya currently has a pipeline of over 2.75 GW of new power generation projects under development, including an estimated 686 megawatts (MW) of solar.[2]

While public and private investment in renewable energy generation has increased available energy capacity, the variable nature of renewables limits their commercial viability. However, energy storage technologies, when supported by international standards and good regulatory practices, create space for renewable energy diversification by ensuring more consistent energy flows and helping distributors balance renewable energy inputs in the national grid. The Government of Kenya has signaled its intention to phase out the current renewable energy feed-in tariff policy and migrate to a reverse auction system to procure new renewable energy generation capacity, similar to the model used under South Africa's Renewable Energy Independent Power Producer Program.

[1] Power Africa. "Development of Kenya's Power Sector, 2015-2020."
[2] Briefing Memo 2.1.

Energy storage allows distributors to provide power when it is needed, rather than when it is best generated. If deployed effectively, energy storage can make off-grid energy a reliable and cost-effective option for millions of Kenyans. In addition, if integrated into Kenya's electricity grids, energy storage will help the region integrate more renewable energy into its grid supply, improve the reliability of the current electrical supply, and defer significant investments from generation to new transmission and distribution capacity.

The objectives of this workshop were to foster discussion on opportunities in the Kenyan market as well as crosscutting issues affecting other East African markets and beyond. This workshop brought together leading experts in both the public and private sectors and feature presentations by U.S. and Kenyan officials to discuss related challenges and opportunities for energy storage standards, conformance, and technology development.

## WORKSHOP SUMMARY

In this context, on May 24-25, 2018, U.S. Trade and Development Agency (USTDA) held the "Energy Storage Standards, Conformance and Technology" workshop in Nairobi, Kenya, which the American National Standards Institute (ANSI) organized under the USTDA-funded U.S.-Africa Clean Energy Standards Program (CESP). The Kenyan Ministry of Energy (MOE) co-hosted this workshop with USTDA in close coordination with the Kenya Power and Lighting Company (KPLC).

This fourth workshop under the CESP, the "Energy Storage Standards, Conformance, and Technology," created an early dialogue about the standards considerations for energy storage in Kenya, particularly as the MOE is considering the development of an energy storage strategy to complement the Kenyan National Energy Policy. This workshop brought together leading experts from the public and private sectors, featuring presentations by U.S. and Kenyan participants on related challenges and opportunities for energy storage standards, conformance, and technology development.

The workshop was attended by 82 participants from 5 countries: Kenya, Mauritius, South Africa, Uganda, and the United States. The workshop was attended by 5 U.S. companies (CBK Energy Solutions Inc., Eaton Corporation, Outback Power, Tesla, and Underwriters Laboratories), U.S. government experts representing the California Public Utilities Commission and Power Africa, as well as, several Kenyan government bodies, including the MOE and the Kenya Energy Regulatory Commission (ERC). The workshop was also attended by a variety of African and international organizations. These included African private sector companies, such as Aurecon from South Africa and Equatorial Power of Uganda, as well as the Kenyan utilities, Kenya Power and Lighting Company Limited (KPLC) and Kenya Electricity Generating Company Limited (KenGen), and industry groups like the Kenyan Association of Manufactures (KAM) and the Kenya National Chamber of Commerce and Industry (KNCCI). For more information on workshop participants, please see the separately submitted participant lists.

Fifteen speakers discussed varying aspects of the African energy storage and renewable energy integration standards and regulation. Four U.S. private sector speakers from Tesla, CBK Energy Solutions, Outback Power, and Underwriters Laboratories (UL) provided expertise from field experience and current research, while the remaining 11 speakers were composed of a variety of African, U.S., and international energy storage experts including the California Public Utilities Commission (CPUC), the Kenyan ERC, MOE, and Kenyan utilities KenGen and KPLC. Additionally, the South African–based Energy

Unit for Aurecon, an engineering and infrastructure advisory company, gave feedback on experiences with grid compliance and the integration of renewable energy in the South African energy market.

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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

Energy storage promotes an enabling environment for clean energy and transboundary natural resource management. If deployed effectively, energy storage can make the delivery of off-grid energy a reliable and cost-effective option for millions across Kenya. In addition, if integrated into Kenyan electricity grids, energy storage can help integrate more renewable energy into its grid supply, improve the reliability of the current electrical supply, and defer significant investments into new transmission and distribution capacity.

Along with South Africa and Nigeria, Kenya has been identified as one of Sub-Saharan Africa's most promising markets for the energy storage sector. Integrating energy storage technologies with the growing number of wind and solar projects would increase the capacity of Kenya's electrical grid to include intermittent generation sources. Energy storage could particularly benefit Kenya's telecommunications, manufacturing, and tourism sectors that are highly dependent on reliable power.[3]

70% of Kenya's 2.3 GW installed generation capacity consists of renewable sources, with enormous potential to expand that base. Power Africa estimates that renewable sources will make up more than 80% of Kenya's energy mix by 2020 and over 60% of Kenya's total generation will be performed by IPPs. The Ministry of Energy (MOE) anticipates peak electricity demand will exceed 15 GW by 2031, and the national development strategy, Vision 2030, aims to meet that need through the expansion and diversification of the country's renewable energy generation capacity. Kenya currently has a pipeline of over 2.75 GW of new power generation projects under development, including an estimated 686 megawatts (MW) of solar.[4]

According to the MOE, Kenya has the potential to produce 10,000 MW of geothermal power from the Rift Valley Basin. The United Nations Environment Program (UNEP) further estimates that Kenya's wind capacity could be as high as 3,000 MW.[5] Energy storage systems are rapidly innovating and becoming more cost effective. These developments present the potential to offset the need for expensive fossil fuels for peaking power, allow power providers to store energy locally at renewable farms, discharge energy during peak demand periods, and smooth the variable generation output across the grid.

[3] Briefing Memo 2.1.
[4] Briefing Memo 2.1.
[5] Power Africa. Retrieved from https://www.usaid.gov/powerafrica/kenya

Despite rapid investments, Kenya has been unable to meet its growing electricity demands. However, energy storage systems present an opportunity to augment electricity supplies by increasing the viability and affordability of renewable energies as storage devices, including batteries, help to level out power supply to prevent overloads and blackouts. These devices will help Kenya utilize renewables as a supplement to the main grid as well as in stand-alone off-grid sites.

The Government of Kenya has implemented a number of policies to help encourage investment in solar, including establishing a feed-in tariff of $0.12 per kilowatt-hour for grid-connected solar plants up to 40 MW. The Government of Kenya has also eliminated the import duty and removed the value added tax on renewable energy technologies, including solar panels and equipment. These enabling policy and regulatory changes, combined with the falling capital costs of solar PV, have motivated a number of new solar independent power producer entrants to the market, including five project developers that are currently beneficiaries of USTDA grant funds.[6]

Installation codes, standards, and conformity assessment form the foundation for safe and interoperable electrical systems. As Kenyan utilities, IIPs, and residential property owners consider deployment of energy storage systems, relevant authorities must have the necessary understanding to evaluate these technologies to ensure safety and promote reliability. For this reason, standards are a foundational component to build out Kenyan electrical systems, including distributed generation.

The adoption of a U.S.-style safety system would 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.

For 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, quality and safe products are paramount. Additional customers include firms involved in engineering, procurement and construction of electric power facility infrastructure in the region. Taking into account the current annual level of U.S. exports of utility equipment to Kenya, one can estimate the addressable market to be at least 7 million. Using similar estimates for the East Africa region, the addressable market is estimated to be at least USD 128 million annually.

*A complete breakdown of the U.S. electrical exports by EAPP member is included in *Appendix A*.

[6] Briefing Memo 2.1.

Appendix A. Relevant U.S. Export History to East Africa

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 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:<br>Not fitted with connectors and of copper;<br>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 Database 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 countries in East Africa, excluding South Sudan due to a lack a data availability. 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.

## FAS Value for East Africa
## U.S. Domestic Exports
## Data from 2014-2017

| Country | 2014 | 2015 | 2016 | 2017 | Percent Change 2016 - 2017 |
|---|---|---|---|---|---|
| | | | *In 1,000 Dollars* | | |
| **Burundi** | 17 | 42 | 10 | 49 | 377.7% |
| **Egypt** | 67,223 | 75,087 | 88,110 | 106,739 | 21.1% |
| **Ethiopia** | 18,438 | 4,135 | 13,609 | 5,097 | -62.5% |
| **Kenya** | 3,741 | 3,848 | 6,380 | 7,157 | 12.2% |

| | | | | | |
|---|---|---|---|---|---|
| **Libya** | 72,206 | 2,186 | 1,089 | 5,929 | 444.5% |
| **Rwanda** | 135 | 86 | 189 | 200 | 5.9% |
| **Sudan** | 40 | 0 | 27 | 44 | 62.2% |
| **Tanzania** | 8,320 | 1,431 | 1,470 | 1,788 | 21.7% |
| **Uganda** | 1,063 | 938 | 756 | 1,171 | 54.8% |
| **Total** | **171,183** | **87,754** | **111,641** | **128,175** | **14.8%** |