



## **U.S.-AFRICA CLEAN ENERGY STANDARDS PROGRAM**

### **Public Market Report:**

### **West Africa Battery Storage Workshop**

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

Produced through cooperation between  
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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**

### **West Africa Battery Storage Workshop**

**December 2-3, 2019**

**08:30 AM – 5:00 PM**

**King Fahd Hotel**

**Dakar, Senegal**

#### **BACKGROUND**

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. These benefits have the potential to substantially improve both on- and off-grid efficiency and reliability.

As energy grids modernize and intermittent energy becomes increasingly popular in West Africa, governments are beginning to explore energy storage solutions to provide frequency regulation, primary and secondary reserve, and manage the variable output of renewable energy projects. For example, Senelec, Senegal's national electricity company has concluded that it needs to add at least 80 MWh of storage to the national grid, following three grid-stability and battery studies. Governments of Burkina Faso, Ghana, and others in the West Africa region are also exploring energy storage options. When considering West Africa as a whole, one of the participating U.S. manufacturers estimated that the addressable market for battery energy storage would be \$4.5 billion in 2020 and \$5.5 billion in 2021.

For these reasons, the "West Africa Battery Storage Workshop" addressed various aspects of energy storage such as the need for BESS in West Africa; BESS technologies; li-ion batteries; safety and regulatory considerations; case studies; environmental considerations; and standards solutions for emerging storage technologies to assist in the deployment of safe and effective storage systems in West Africa.

The objectives of this workshop were to foster discussion on collaborative and export opportunities in the Senegalese and West African markets. This workshop brought together leading experts from both the U.S. and West African public and private sectors and featured presentations by U.S. and West African officials discussed challenges and opportunities for BESS, standards, regulatory considerations and emerging technology.

#### **WORKSHOP SUMMARY**

On December 2-3, 2019, the U.S. Trade and Development Agency (USTDA) hosted the "West Africa Battery Energy Storage Workshop" in Dakar, Senegal. The workshop was organized by the American National Standards Institute (ANSI) under the USTDA-funded U.S.-Africa Clean Energy Standards Program (CESP).

In recent years, battery energy storage systems (BESS) have risen in popularity due to their utility in managing variable energy resources (VERs) and supporting grid stability. These systems have gained popularity across West Africa as certain governments are prioritizing energy storage systems to help increase sustainable development. As a result, there has been an emphasis on renewable energy investment to support West African goals of universal energy access. As West African nations incorporate more VERs, such as wind and solar, into their national energy mix, the need for viable BESS will become increasingly important.

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BESS 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 West Africa. When added to national electricity grids, energy storage can help integrate more VREs into national energy mix, improve the reliability of the current electrical supply, and defer significant investments into new transmission and distribution capacity. Additionally, energy storage increases grid flexibility and can offset the need to use diesel and other fossil fuels for peaking power.

The effective deployment of BESS across West Africa will depend on large levels of investment, which will hinge on the stability of the energy policy environment including fiscal incentives, regulations, national access policies, and standards. These policies will also ensure that West African citizens receive high-quality, reliable, and safe technology to support universal energy access.

There is a great need for BESS in West Africa, and particularly Senegal, as it will help augment solar and wind power to improve reliability of energy systems and increase energy access for rural communities. In Senegal, the nation is actively seeking methods to minimize energy costs, diversify the national energy mix, and increase rural electrification through a series of initiatives. The Senegalese utility, Senelec, has concluded that Senegal needs to add at least 80MWh of storage to the national grid alone and will likely seek additional storage to support off-grid systems and the country's universal energy access goal. This is particularly true for many West African nations where electricity access in rural areas is low. For example, in Senegal, approximately 40 percent of the rural population has access to electricity.<sup>1</sup>

As Senegal, and many other West African nations, look for ways to bolster energy access through the incorporation of a variety of energy resources, BESS will become increasingly important, as will the standards, policies, and regulations that underpin safe and reliable systems. This workshop provided a valuable and timely platform for stakeholders and experts to share information on various energy methods to support West African electrification goals.

The workshop attracted more than 75 participants from the U.S., Europe, and West Africa. The event provided participants with a thorough understanding of BESS including standards to support quality and safety, emerging storage technologies, and use cases for BESS. This workshop fostered discussions of crosscutting issues and opportunities for U.S. – West Africa cooperation.

Presentations and photos from the workshop are available on the CESP website: [www.standardportal.org/us-africacesp](http://www.standardportal.org/us-africacesp).

### MARKET OPPORTUNITY

Despite the availability of vast energy resources across the 15 ECOWAS member states, the energy market in West Africa remains predominately underdeveloped.<sup>2</sup> This is particularly true for Senegal where only 40 percent of the rural population has access to electricity.<sup>3</sup> Due to this issue, Senegal projects that, by 2030, it will need to produce 2,000MW of renewable energy to satisfy the local energy demands and to improve grid efficiency and diversify the national energy mix.<sup>4</sup> As ECOWAS members, like Senegal,

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<sup>2</sup> Ren 21 Report ECOWAS [https://www.ren21.net/wp-content/uploads/2019/05/ECOWAS\\_EN.pdf](https://www.ren21.net/wp-content/uploads/2019/05/ECOWAS_EN.pdf)

<sup>3</sup> Power Africa <https://www.usaid.gov/powerafrica/senegal>

<sup>4</sup> Africa Oil and Power <https://africaoilandpower.com/2019/08/09/senegal-to-boost-electricity-production/>

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continue to prioritize the expansion and modernization of energy services, the market opportunity for battery energy storage systems (BESS) to support variable energy resources (VERs) will increase.<sup>5</sup>

As the ECOWAS region confronts its energy challenges and attempts to increase urban and rural electrification through the incorporation of VERs to the regional energy mix, BESS will become a critical feature to promote grid flexibility and offset the need to use fossil fuels for grid management. 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 West Africa. In addition, if integrated into West African electricity grids, energy storage can help integrate more renewable energy into national grid supplies, improve the reliability of the current electrical supply, and defer significant investments into new transmission and distribution capacity.

Emblematic of this shift, Senegal's national electricity company, Senelec, has concluded that Senegal needs to add at least 80MWh of storage to the national grid, following three grid-stability and battery studies. Other West African nations, including Burkina Faso, Cote d'Ivoire, and Ghana are also exploring BESS solutions as a cost-effective option for enabling power systems to integrate large shares of variable renewable energy. These developments demonstrate the increasing demand for energy solutions and the large energy market opportunity in West Africa.

Many donors have recognized this opportunity to invest in West Africa. A prime example is the World Bank's Regional Off-Grid Electrification Project (ROGEP), which provides over \$200 million to help the West African Development Bank and the ECOWAS Center for Renewable Energy and Energy Efficiency (ECREEE) expand off-grid access to electricity across 19 nations in West Africa. The World Bank estimates that ROGEP will help 1.7 million people who are currently living without electricity or with unreliable electricity.<sup>6</sup>

As international donors and national governments continue to invest in alternative energy resources and increase the amount of VREs in their national energy mix, BESS will become a critical feature to support the leveling of energy flows, grid management services, and back up generation. These benefits can be supported through the adoption of U.S.-style safety systems. The 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.

When considering the current West African energy landscape, one of the participating U.S. manufacturers estimated that the addressable market for battery energy storage to be \$4.5 billion in 2020 and \$5.5 billion in 2021.

For U.S. companies, more broadly, the primary customers are likely electrical generation, transmission, and distribution utilities located across Africa. 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 the ECOWAS region, one can estimate the existing annual addressable market to be at least USD 1.87 million. Using similar estimates for the ECOWAS region, the addressable market is estimated to be at least USD 92.53 million annually.

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

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<sup>5</sup> Ren 21 Report (ECOWAS) [https://www.ren21.net/wp-content/uploads/2019/05/ECOWAS\\_EN.pdf](https://www.ren21.net/wp-content/uploads/2019/05/ECOWAS_EN.pdf)

<sup>6</sup> The World Bank <https://www.worldbank.org/en/news/press-release/2019/04/22/world-bank-provides-2247-million-to-help-increase-access-to-electricity-in-west-africa-and-the-sahel-region>

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### 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:

<b><i>HTS number</i></b>	<b><i>Product description</i></b>
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

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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 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 15 ECOWAS countries. The table below shows the result of exports over the past three years to countries in ECOWAS. 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 ECOWAS**  
**U.S. Domestic Exports**  
**Data from 2015-2018 (and up to Q3 2019)**

Country	2015	2016	2017	2018	2019 YTD
	<i>In 1,000 Dollars</i>				
<b>Benin</b>	134	4,816.75	153.81	196.44	57.72
<b>Burkina Faso</b>	147.06	312.5	1,043.62	240.35	374.16
<b>Cabo Verde</b>	83.09	22.88	2.6	22.27	61.66
<b>Cote d'Ivoire</b>	6,224.47	2,457.96	2,173.04	2,289.36	1,957.21
<b>The Gambia</b>	87.91	24.27	52.53	114.51	21.91
<b>Ghana</b>	33,702.36	32,781.71	114,646.11	11,963.95	13,853.73
<b>Guinea</b>	465.71	196.41	438.78	1,188.47	239.95
<b>Guinea-Bissau</b>	20.33	53.45	12.18	0	0

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<b>Liberia</b>	5,165.41	3,380.15	1,168.63	6,351.02	1,497.86
<b>Mali</b>	1,720.97	4,739.11	2,574.24	1,173.52	723.49
<b>Niger</b>	1,554.54	427.9	1,628.36	849.03	2,002.24
<b>Nigeria</b>	63,056.36	47,641.44	28,890.91	43,557.81	32,981.94
<b>Senegal</b>	3,252.91	750.53	2,182.12	1,294.04	2,176.27
<b>Sierra Leone</b>	581.19	772.38	381.26	335.13	1,406.9
<b>Togo</b>	17.07	103.73	92.72	57.3	31.55
<b>Total</b>	<b>116,213.39</b>	<b>98,481.17</b>	<b>155,440.92</b>	<b>69,633.21</b>	<b>57,386.59</b>