

# Session 6: Innovation Energy Storage for Federal Installations



## Playing the Entire Value Chain for Energy Storage

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# The Stella Group, LTD

The Stella Group, Ltd.. is a strategic technology optimization and policy firm for clean distributed energy users and companies which include advanced batteries and controls, energy efficiency, fuel cells, geexchange, heat engines, microhydropower (including tidal and wave), modular biomass, photovoltaics, small wind, and solar thermal (including CSP, daylighting, water heating, industrial preheat, building air-conditioning, and electric power generation).

Scott Sklar serves as Steering Committee Chair of the Sustainable Energy Coalition, composed of the renewable and energy efficiency associations, national environmental groups, and analytical groups, and sits on the national Boards of Directors of the non-profit Business Council for Sustainable Energy and The Solar Foundation and teaches two unique interdisciplinary sustainable energy course at The George Washington University.

Scott Sklar was awarded the prestigious The Charles Greely Abbot Award by the American Solar Energy Society (ASES) and on April 26, 2014 was awarded the Green Patriot Award by George Mason University in Virginia, and serves as Chair of the US Department of Commerce Renewable Energy & Energy Efficiency Advisory Committee, term ending 2016.

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# Types of projects over the last 15 years

- Net Zero Energy building – Washington Navy Yard, DC
- Zero energy buildings
  - Two totally off-the-grid in Arlington, VA
  - 127 buildings worldwide
- Critical infrastructure project – Davis-Monthan AFB, AZ
- AxionPower – one MW battery bank on PJM Grid, PA
- APS – one MW battery bank by AES, AZ
- Cell towers – totally on-site RE DG with battery banks in Morocco, AZ, and West Africa
- Various projects during and post-Katrina in MS and LA working for Gov of MS, and CCI for New Orleans

# Market drivers

All my projects for 15 years have revolved around these four energy storage market drivers:

1. Dedicated to critical circuits for absolute power quality (preventing surges sags, transients) and/or frequency control as the distribution grid ages and becomes more fragile
2. Dedicated to critical functions for absolute electric power reliability to insure communications, internet, manufacturing controls, security, signage, etc.
3. Arbitraging higher electricity sub-rates (expressed as demand charges, peak & seasonal power rates, and in some states spot/ratchet rates)
4. Solely power critical infrastructure with charging inputs by on-site renewable energy for cellular towers, data centers, monitoring systems, signal lights (railways, roadways, harbor ways, etc), and all sorts of security and sensing systems, etc.

# Market & technology transitions

## **Grid-connected solar-plus battery systems are coming....and could soon supply the majority of customers' electricity needs**

The way we get power is “at a metaphorical fork in the road,” says the report “The Economics of Load Defection” released in October 2014 by the Rocky Mountain Institute, an influential energy policy think tank. The reason is not just rooftop solar but, beyond that, the growing feasibility of home electricity systems combining solar panels with batteries for storage of energy. “Grid-connected self-consuming solar will become economic for nearly all customers imminently, with grid-connected solar plus-battery systems following soon after,” notes the study, which was co-authored by Homer Energy. [http://www.rmi.org/electricity\\_load\\_defection](http://www.rmi.org/electricity_load_defection).

## **Renewable Energy Accounts for 70% of New U.S. Generating Capacity in First Half of 2015**

-Ken Bosson | July 22, 2015

Renewable sources —biomass, geothermal, hydropower, solar, wind—accounted for nearly 70 percent (69.75 percent) of new electrical generation placed in service in the U.S. during the first six months of 2015. According to the recently-released “Energy Infrastructure Update” report from the **Federal Energy Regulatory Commission’s (FERC) Office of Energy Projects**, 18 new “units” of wind accounted for 1,969 megawatts (MW) of new generating capacity—or more than half of all new capacity year-to-date. Among renewable sources, solar followed with 549 MW (71 units), biomass 128 MW (7 units), geothermal steam 45 MW (1 unit) and hydropower 21 MW (1 unit). Twenty-one units of natural gas contributed 1,173 MW. FERC reported no new capacity for the year-to-date from oil or nuclear power and just 3 MW from one unit of coal.

SOURCE: <http://ecowatch.com/2015/07/22/renewables-first-half-2015/>

# Recent articles of note

## **Report Identifies Hot Spots for Distributed Energy Storage in the U.S.**

GreenTechMedia.com, by Mike Munsell, August 20, 2014

<http://www.greentechmedia.com/articles/read/Where-is-Distributed-Energy-Storage-Being-Deployed-in-the-US>

According to GTM Research's "Q2 2014 Grid Edge Executive Briefing," there are approximately 270 distributed energy storage projects (deployed and planned) across the U.S. The number of projects is up from 120 at the end of 2013, and combined, the total is 212 megawatts. U.S. distributed storage projects range in size from 5 kilowatts to more than 5 megawatts, but the majority of projects are rated less than 750 kilowatts. The deployments tend to be concentrated in Hawaii, California and the Northeast. GTM Research forecasts 720 megawatts of distributed storage to be deployed in the United States between 2014 and 2020.

## **Lead Acid Battery Maker Axion to Supply 9.1-MW Pennsylvania Solar Farm:**

New Vision, November 1, 2014

[http://www.renewablesbiz.com/article/14/11/lead-acid-battery-maker-axion-supply-91mw-pennsylvania-solar-farm?utm\\_source=2014\\_11\\_03&utm\\_medium=eNL&utm\\_campaign=RB\\_DAILY&utm\\_term=D&utm\\_content=108834](http://www.renewablesbiz.com/article/14/11/lead-acid-battery-maker-axion-supply-91mw-pennsylvania-solar-farm?utm_source=2014_11_03&utm_medium=eNL&utm_campaign=RB_DAILY&utm_term=D&utm_content=108834)

Axion Power International, a maker of lead carbon battery systems, has been selected to supply energy storage and frequency regulation to a 9.1- MW solar farm in Pennsylvania.

# Where the energy storage expansion will happen first ...

**... and why the commercial-industrial segment of the market is ready to buy in** --- By Herman K. Trabish  
(1/7/2015)

People who watch the energy storage market say they now know where and how it will break out commercially.

New numbers show solar plus storage technology, on the strength of 20%-plus annual price drops over the last 4 years, is on the verge of turning into a billion dollar market by 2018, Utility Dive just reported.

*"This \$6 billion energy market is a huge opportunity,"* said Clean Coalition Economics & Policy Analysis Director Kenneth Sahm White. *"The value proposition is there. The questions are how smoothly the market will open up, how fast it will happen, and who will get the economic benefits."*

[http://www.utilitydive.com/news/where-the-energy-storage-expansion-will-happen-first-and-why/346265/?utm\\_source=Sailthru&utm\\_medium=email&utm\\_term=Utility%20Dive&utm\\_campaign=Issue%3A%202015-01-08%20Utility%20Dive%20Newsletter#.VQ7YT0clTEo.mailto](http://www.utilitydive.com/news/where-the-energy-storage-expansion-will-happen-first-and-why/346265/?utm_source=Sailthru&utm_medium=email&utm_term=Utility%20Dive&utm_campaign=Issue%3A%202015-01-08%20Utility%20Dive%20Newsletter#.VQ7YT0clTEo.mailto)

# Frequency control

In a 2013 article, Janice Lin (Strategen Consulting and CA Energy Storage Alliance) said:

*"The Challenge is that frequency regulation markets are not that big, and it's a day-ahead market. The question is, can storage get bankable long-term contracts?"*

Response to her question - Sklar view:

Frequency control will grow, but primarily driven either by electric utilities or by certain regional transmission organizations. This is a slow ramp-up market and not a way to build a business.

# Battery storage gaining more traction

## [NY Working Hard to Catch Up with CA's Energy Storage Requirements](#)

Posted: 21 Jan 2014 02:43 PM PST ----- *Bill Radvak*

Battery storage is gaining more and more traction in the distributed energy resources community. Last fall, California passed the first statewide energy storage directive in the United States. Issued by the California Public Utilities Commission (CPUC), the mandate requires all investor-owned utilities in the state including Southern California Edison, Pacific Gas & Electric and San Diego Gas & Electric, to jointly purchase “1325 megawatts of energy storage” by 2020.

“The proposed targets increase between 30% and 55% every two years, creating economic incentives for multiple players with various technologies to enter the market” reports Energy Storage North America in a press release. Utilities will be allowed to employ energy storage for a variety of functions, such as capacity, ancillary services, and peak shaving, which in turn will provide real-world data for further market expansion. ----- continued →

## (continued)

Utilities may own some energy storage systems, and will procure at least 50% from independent developers across all segments of the grid via existing procurement processes or “all-source” solicitations starting in 2014. In his **State of the State speech** in Albany this month, the Governor and Vice President Biden championed community based microgrid solutions as part of his “Reimagining New York for a New Reality” initiative which is a \$17 billion strategy that will transform the state’s energy supply, infrastructure, emergency management, etc., to protect people from future extreme weather. *“Our plan completely transforms the way we build and protect our infrastructure, safeguard our energy supply, prepare our citizens and first responders, and provide fuel and electricity,”* said Governor Cuomo. Cuomo’s mandate to launch new projects across the state that both create green jobs and protect New York's natural environment is a critical economic reform in this year’s budget.

# California driving the utility-scale storage market

## ***California Energy Commission to Issue \$120M in Solicitations for Energy Resiliency, Smart Grid, Efficiency, Grid Planning (7/23/15)***

The California Energy Commission plans to issue solicitations for energy resiliency, smart grid, and other energy technology and programs totaling more than \$120 million in the second half of 2015.

Get the full story here:

<http://microgridknowledge.com/california-energy-commission-to-issue-120m-in-solicitations-for-energy-resiliency-smart-grid-efficiency-grid-planning>

# Four trends

## Short Term

1. power quality
2. arbitraging sub-rates

## Medium Term

3. resiliency (if not de-regulated, this flips to #2)
4. reliability

**Note:** first play critical shared infrastructure

But please note, these markets will not be penetrated by larger companies most likely. but more agile, smaller technology companies.

## Five kinds of market focus:

- utilities (slow, uneven, and state-based)
- commercial/industrial/institutional (my markets) \*\*
- infrastructure (mostly on-site at towers, pumps, etc) \*\*
- government – military & remote \*\*
- residential (e.g., Tesla & Solar City, etc.)

# Challenges for the battery “system” industry

Not only as battery manufacturers but as system integrators.

Blend strengths with storage as part of the storage technology arsenal ...

- smart controls and software
- combined heat and power (CHP)
- load reduction options – LED, efficient HVAC

Need to fill in the gaps:

- smart and directional switching – when grid goes down , immediate transfer of solar and wind to battery storage to critical functions

## Point of note

My global corporate and government clients have included battery banks with on-site energy because it is cost effective if you monetize the four asset values in an on-site cost-benefit analysis.

- The regulatory and analytical fields are solidly advancing utilization of battery storage as a tactic for a more resilient energy system.
- Financing venues already available for on-site high-value energy efficiency (shared savings) and distributed generation [leasing and power purchase agreements (PPAs )] have been anecdotally used for battery banks

# When will battery banks become more commonplace in the market?

Until battery storage systems become standardized, modular, interoperable, and more service-friendly, with web-enabled color-coded diagnostics, their use will be limited. They must follow the approach that solar, wind, and CHP systems began to incorporate 15 years ago and that now has allowed them to scale into the market .

Large companies focus on technology optimization, not optimization and ease for the user. More diverse form factors are needed to allow faster integration into buildings, along infrastructure, and greater versatility for use during emergencies.

And finally, smarter approaches than bundling hundreds of wires needs to be re-considered and supplanted with easier-to-service approaches (think laptop batteries ). Unless this is done, battery banks will not reach their market potential as fast as desired. We need systems integrators who could be battery manufacturers who are ideally positioned to fill this void.

# Financing

## Stem Offers Power-Storage Systems Using Solar Lease Model

Bloomberg.com, by Justin Doom, October 24, 2013

<http://about.bnef.com/bnef-news/stem-offers-power-storage-systems-using-solar-lease-model>

Stem Inc. is offering to install about 15 megawatts of systems using a \$5 million investment from Clean Feet Investors I LLC. The company is offering commercial and industrial customers long-term financing options with no upfront costs that are similar to the solar leases and power-purchase agreements widely used by companies including SolarCity Corp. and Sunrun Inc. The battery systems let customers reduce their peak power-demand expenses and cut utility bills by 10 percent to 40 percent. The batteries store power from the grid during non-peak hours for use during peak periods. A typical commercial customer will use three of Stem's 18-kilowatt systems, which cost about \$97,000. Most contracts will be for 10 years, and customers will have the option to buy the systems.

# Utility moves

POSTED: 01:30 a.m. HST, Jan 07, 2014

In particular, Hawaiian Electric Co. and the Hawaii Natural Energy Institute are partnering on a project, due to begin by the second quarter of this year, to try out battery technology in West Oahu, one area where photovoltaic solar systems have particularly high market penetration.

It will employ a 1-megawatt lithium-ion battery to be installed between the HECO Campbell Industrial Park substation and a distribution circuit serving homes that have more than 3 megawatts of PV capacity. The mission is to gain a clearer understanding of how to use the storage technology to keep voltages constant on circuits with high PV use.

The energy institute also is working on Molokai with Maui Electric Co., a HECO subsidiary, on another, similar battery-storage test. This momentum should not be surprising, given the explorations being made by the private industry to promote a battery-enabled transition "off the grid" for their customers.

[http://www.staradvertiser.com/editorialspremium/20140107\\_Better\\_batteries\\_will\\_boost\\_PV\\_use.html?id=238990301](http://www.staradvertiser.com/editorialspremium/20140107_Better_batteries_will_boost_PV_use.html?id=238990301)

# Recent energy storage studies

## CALIFORNIA

### **Cost-Effectiveness of Energy Storage in California**

[http://www.cpuc.ca.gov/NR/rdonlyres/1110403D-85B2-4FDB-B927-5F2EE9507FCA/0/Storage\\_CostEffectivenessReport\\_EPRI.pdf](http://www.cpuc.ca.gov/NR/rdonlyres/1110403D-85B2-4FDB-B927-5F2EE9507FCA/0/Storage_CostEffectivenessReport_EPRI.pdf)

## TEXAS

### **The Value of Distributed Electricity Storage in Texas (Nov 2014)**

[http://www.brattle.com/system/news/pdfs/000/000/749/original/The\\_Value\\_of\\_Distributed\\_Electricity\\_Storage\\_in\\_Texas.pdf](http://www.brattle.com/system/news/pdfs/000/000/749/original/The_Value_of_Distributed_Electricity_Storage_in_Texas.pdf)

## FERC – DG

**The Potential Benefits of Distributed Generation and Rate-related Issues that may impede their Expansion.** A Study pursuant to Section 1817 of the Energy Policy Act of 2005 (Feb. 2007)

<https://www.ferc.gov/legal/fed-sta/exp-study.pdf>

**There are no dumb  
questions!**

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