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Submit your questions at any time by typing in the Question Box and hitting Send.

This webinar is being recorded.

You will find a recording of this webinar, as well as previous Resilient Power Project webinars, online at:

www.resilient-power.org
Who We Are

www.cleanegroup.org

www.resilient-power.org
Resilient Power Project

• Increase public/private investment in clean, resilient power systems
• Engage city officials to develop resilient power policies/programs
• Protect low-income and vulnerable communities
• Focus on affordable housing and critical public facilities
• Advocate for state and federal supportive policies and programs
• Technical assistance for pre-development costs to help agencies/project developers get deals done

• See www.resilient-power.org for reports, newsletters, webinar recordings
www.resilient-power.org
Today’s Speakers

- **Brett Simon**, Analyst, Energy Storage, GTM Research
- **Ravi Manghani**, Director, Energy Storage, GTM Research

Prepared For:

CleanEnergy States Alliance

Brett Simon - Analyst, Energy Storage
Ravi Manghani - Director, Energy Storage

August 2016
About Greentech Media

**News/Online**

Greentech Media delivers business-to-business news, analysis and events at the forefront of the global energy transformation. Our coverage area extends across the clean energy industry with a focus on solar power and the electric utility market’s evolution. Greentech Media’s industry-leading coverage is provided by a team of analysts from our market intelligence arm, GTM Research, as well as our world-class journalists and global network of expert contributors.

**Research**

GTM Research is the market analysis and consulting arm of Greentech Media. GTM Research is comprised of analysts covering solar, grid edge, and energy storage markets. Our analysts combine diverse backgrounds in energy, environmental, emerging technology, information technology and strategic consulting sectors. This diverse team provides critical and timely market analysis in the form of research reports, consulting, and data subscription services.

**Event**

Greentech Media and GTM Research experts come together to produce all of Greentech Media’s industry conferences throughout the year. These summits provide a platform for our latest market intelligence and draw together the industry influencers from organizations across the value chain.
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1. Deployment Trends
Q1 2016 Deployments Grew 127 Percent Year-Over-Year to 18.3 MW

Front of the Meter

Behind the Meter

Total

Behind-the-Meter Sector Continues 4-Quarter Trend of Deploying at Least 10 MWh in Q1 2016

Front of the Meter

Behind the Meter

Total

California and PJM (Excl. NJ) Account for 92 Percent of Deployments Since Q1 2013

<table>
<thead>
<tr>
<th>Rank</th>
<th>Residential</th>
<th>Non-Residential</th>
<th>Utility</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>California</td>
<td>California</td>
<td>PJM (excl. NJ)</td>
</tr>
<tr>
<td>2</td>
<td>All Others*</td>
<td>All Others*</td>
<td>California</td>
</tr>
<tr>
<td>3</td>
<td>Hawaii</td>
<td>New Jersey</td>
<td>All Others*</td>
</tr>
</tbody>
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*GTM Research is currently monitoring seven individual markets. Complete coverage of all markets is available in the full report.

Lithium-Ion Technology Comprised 97% Of Deployments in Q1 2016

Quarterly Energy Storage Deployment Share by Technology (MW %)

**Other** includes flywheel and unidentified energy storage technologies

2. Market Drivers
Front-of-the-Meter Policy and Market Developments, Q1 2016

**Colorado**
- **Colorado PUC** approved two energy storage projects proposed by Xcel Energy.

**Nevada**
- **PUCN** opened an investigation into battery storage technologies and held a workshop to discuss the role of energy storage.

**California**
- **PG&E**, **SCE** and **SDG&E** filed their 2016 Biennial Storage Procurement Plans. **SDG&E** issued 2016 LCR RFO to seek up to 140 MW of preferred resources, including energy storage; also signed a contract with **Hecate Energy Bancroft** for 20 MW of energy storage which is pending approval by **CPUC**. The **Bureau of Land Management** approved **ARES’** proposal for a rail-energy storage system to be located in southern NV and provide ancillary services in CAISO. **CAISO** initiated stakeholder process for track 2 of ESDER.

**New York**
- A proposal to extend property tax exemptions to energy storage was amended and passed by the **State Assembly** and was amended by the **State Senate**. **NYSEG** issued an RFP for a non-wire alternative upgrade for the area served by the Java Substation. **NY PSC** updated NY’s standardized interconnection requirements; also issued an Order Adopting Distributed System Implementation Plan Guidance. **NYISO** started initiative to evaluate energy storage participation in existing programs.

**Hawaii**
- **HECO** filed a Power Supply Improvement Plans update report. **SB 2739** proposed to establish a long-duration storage mandate but was deferred.

**Federal**
- The **U.S. Supreme Court** granted a stay on the Clean Power Plan. The **U.S. Senate** passed Grid Modernization Act of 2016, though it still must be reconciled with HR 8. **FERC** issued a notice to hold a technical conference to discuss interconnection requirements; also initiated AD16-20 to allow ISOs the opportunity to provide data on energy storage participation in existing markets.

Front-of-the-Meter Policy and Market Developments, Q1 2016 (Cont.)

**New Jersey**
- NJ BPU approved a $2 million loan for Eos Energy Storage under the Edison Innovation Green Growth Fund.

**Connecticut**
- CT DEEP issued an RFP to procure energy resources, including energy storage.

**Arizona**

**Utah**
- The Utah legislature passed SB 115, which permits utilities to pursue battery storage projects if authorized.

**Virginia**
- HB 452 to establish an Energy Storage Consortium continued to 2017.

**Maryland**
- HB 787 to establish utility targets for energy storage procurement received an unfavorable report and was withdrawn.

**Minnesota**
- Minnesota PUC issued a staff report on grid modernization and Xcel Energy answered comments on its Biennial Grid Modernization Report.

**PJM**
- PJM MRC convened meeting to discuss DER participation; PJM Senior Task Force held meetings to evaluate regulation market.

**Iowa**
- MidAmerican Energy filed its Preliminary Implementation Plan.

**Texas**
- Texas PUC approved Oncor’s application for the Bethel CAES project. ERCOT FAST is working on ancillary redesign; ERCOT DREAM Task Force was disbanded.

Behind-the-Meter Policy and Market Developments, Q1 2016

California
CPUC issued a final decision concerning NEM credit estimation methodology for small storage systems paired with NEM-eligible generation; additionally investigating how to deal with funding allocation issues resulting from February SGIP application process. PG&E, SCE and SDG&E filed their 2016 Biennial Storage Procurement Plans. PG&E filed an advice letter to outline its proposed time-of-use rate pilot plan, which CPUC conditionally approved. SDG&E issued 2016 LCR RFO to seek up to 140 MW of preferred resources, including energy storage. California Energy Commission approved $9 million in grants for the installation of DC fast chargers.

Colorado
Colorado PUC approved two energy storage projects proposed by Xcel Energy.

New York
A proposal to extend property tax exemptions to energy storage was amended and passed the State Assembly and was amended by the State Senate. NYSERDA launched Phase II of NY Prize.

Maryland
The state legislature proposed a tax credit for behind-the-meter energy storage systems.

Hawaii
HB 2507 was introduced and recommended for deferral by Committee on Economic Development and Business. HB 2511 introduced and passed second reading in the state House. HECO and Greenlots initiated a behind-the-meter energy storage and DC fast-charging pilot for EVs. HECO filed a PSIPs update report. SB 2738/HD 2/SD 2 is undergoing discussion in state legislature.

Arizona

ACC, UniSource Energy Services and several intervenors submitted documents concerning UniSource Energy Services' proposed rate changes.

Guam

Guam PUC considering a rebate for residential energy storage systems paired with solar PV.

Nevada

PUCN opened an investigation into battery storage technologies and held a workshop to discuss the role of energy storage.

Texas

ERCOT disbanded the DREAM Task Force.

Federal

The U.S. Senate passed Grid Modernization Act of 2016, though it still must be reconciled with HR 8.

Total Closed Acquisition of Saft

Completed $1.1 Billion Deal Is the Largest in Energy Storage to Date

Tesla and SolarCity Announced $2.6 Billion Merger Deal

Goal to create vertically integrated clean energy company offering solutions across the value chain including energy storage, solar PV and electric vehicles
Front-of-Meter System Price Trends in Q1 2016

Utility-Scale Price Trends Q1 2016 and 2018E, Energy Applications – 2 Hours ($/kWh)

$0
$200
$400
$600
$800
$1,000
$1,200

Q1 2016 System Price Ranges ($/kWh)

Utility (Energy Application, $/kWh) - Q1 2016

$700

Utility (Energy Application, $/kWh) - 2018E

$700
$950
$850
$1,100


Utility-Scale Price Trends Q1 2016 and 2018E, Power Applications ($/kW)

$0
$200
$400
$600
$800
$1,000
$1,200

Q1 2016 System Price Ranges ($/kW)

Utility (Power Application, $/kW) - Q1 2016

$500

Utility (Power Application, $/kW) - 2018E

$750
$900
$1,100


Behind-the-Meter Price Trends in Q1 2016

Behind-the-Meter Price Trends Q1 2016 ($/kWh)

Q1 2016 System Price Ranges ($/kWh)

Residential
- $2,000
- $1,500
- $1,300

Non-Residential
- $1,500
- $1,100
- $950

Wholesale Markets’ Structures Evolving to Include Storage

- **CAISO**: Reduced performance threshold for frequency regulation.
- **CAISO**: Approved DERP framework.
- **PJM**: Reduced RegD cap to 40% from the previous cap of 62%. A Senior Task Force was created to re-evaluate application of marginal benefit function to regulation market.
- **MISO**: Created a platform to address storage-related market rules and questions, ranging from development of a fast AGC signal to tariffs and storage classification.
- **SPP**: Implemented pay-for-performance compensation for frequency regulation.
- **ISO-NE**: Introduced an energy-neutral regulation signal and different parameter sets to track conventional and energy-neutral dispatched resources.
- **ERCOT**: Established the DREAM Task Force to determine protocols and market rules for distributed energy resources. (The taskforce was disbanded in April 2016, having met its objective.)
- **FERC**: Issued an order relating to third-party provision of primary frequency response.

Wholesale Markets’ Structures Evolving to Include Storage (Cont.)

- The CAISO Board of Governors approved changes to the non-generator resource model under ESDER in Feb '16.
- ISO-NE released a white paper to outline energy storage participation requirements in its markets in Mar '16.
- The NYISO Market Issues Working Group initiated an evaluation of programs in which storage can participate, targeting near-term changes to better integrate storage in Mar '16.
- CAISO started work on ESDER – Phase 2 initiative to address multiple-use applications, NGR model enhancements, station power and transmission access charges in Apr '16.
- The PJM Markets and Reliability Committee convened a special meeting to determine most effective and least-cost options to interconnect distributed energy resources in Apr '16.
- The ERCOT Future Ancillary Services Team resumed work on future ancillary services framework in Apr '16.
- FERC issued AD16-20 to examine participation of energy storage in wholesale markets; announced a Technical Conference to explore interconnection issues in Apr '16.

3. Outlook
U.S. Energy Storage Market Will Exceed the 2 GW Threshold in 2021

Energy Storage Deployments by Segment (MW)

- Residential
- Non-Residential
- Utility

U.S. Energy Storage Market Will Be Worth $2.9 Billion by 2021

Thank you!

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