U.S. Energy Storage Monitor

Q1 2015: Executive Summary

May 2015

GTM RESEARCH
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ESA
Energy Storage Association

About This Report

U.S. Energy Storage Monitor is a quarterly publication of GTM Research and the Energy Storage Association (ESA). Each quarter, we gather data on U.S. energy storage deployments, prices, policies, regulations and business models. We compile this information into this report, which is intended to provide the most comprehensive, timely analysis of energy storage in the U.S.

Notes:

- All forecasts are from GTM Research; ESA does not predict future pricing, costs, or deployments
- References, data, charts and analysis from this report should be attributed to "GTM Research/ESA U.S. Energy Storage Monitor"
- Media inquiries should be directed to Mike Munsell (munsell@gtmresearch.com)

For more information or to purchase the full report, visit www.energystoragemonitor.com.

Scope of This Report

- **Capacity Metrics**: We report energy storage capacity and deployments in terms of power capacity (measured in watts). An alternative method would be to report the data in watt-hours, which provides information on the discharge duration at rated power capacity. All of our data sources (details on data sources provided in Appendix), including program administrators, utility companies, utility commissions, and system operators, currently track and report energy storage queue, deployments and interconnections in terms of power capacity: watts, kilowatts or megawatts. GTM Research defines capacity in terms of the interconnected power capacity, and not in terms of the flexible resource capability a given storage asset can provide (charging + discharging).

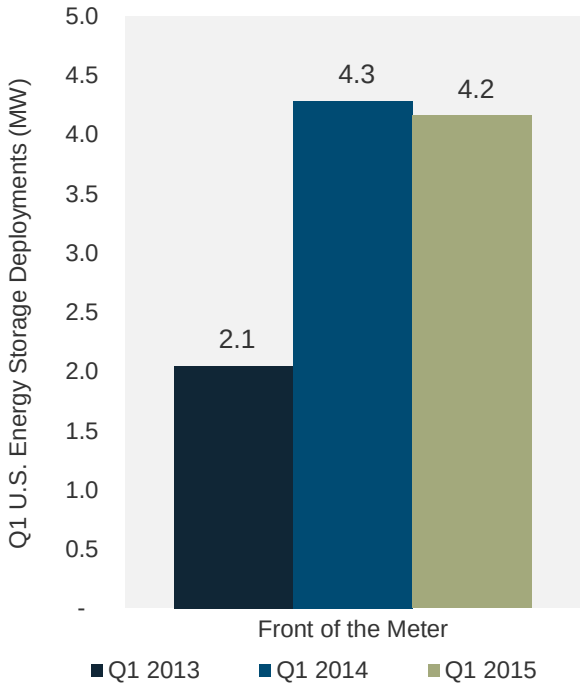
- Please note that some projects are publicly announced based on flexible resource capacity. For these projects, the announced capacity may differ from our capacity totals.

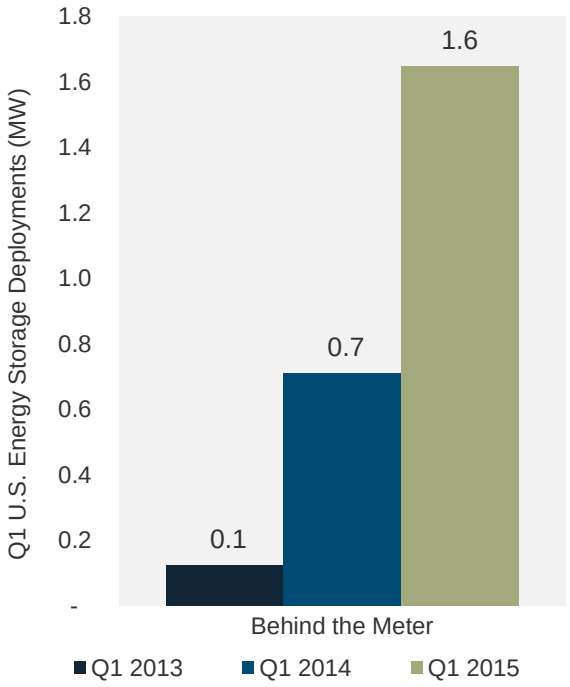
- **Segments**: We report energy storage capacity data in three segments: residential, non-residential and utility scale. Projects that are deployed on the end-customer side of the meter (i.e., behind the meter) are reported as falling in either the residential or non-residential segment. The non-residential segment includes commercial, industrial, education, military and nonprofit deployments, but excludes uninterruptible power supply (UPS). Regardless of their size, projects that are deployed on the utility side of the meter (i.e., in front of the meter) are reported in the utility-scale segment.

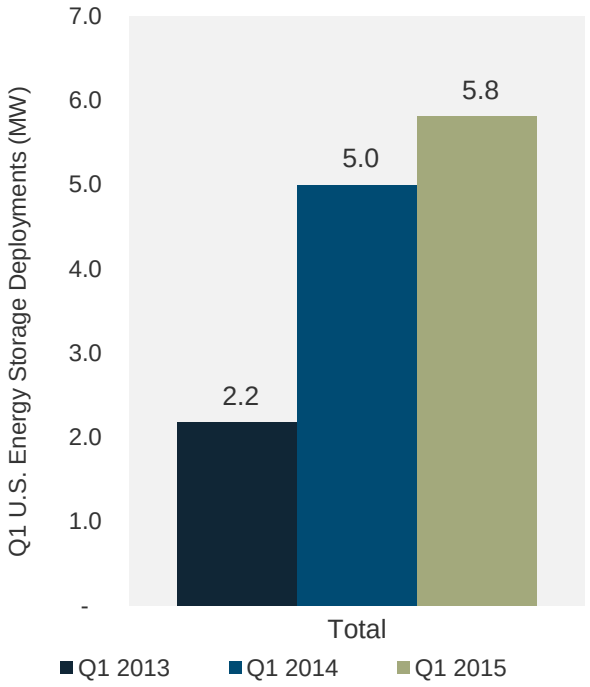
- **Technologies**: Electrochemical (batteries) and electromechanical technologies, excluding pumped hydro, are included in the historical deployment and forecast data.

- **Market Size**: Market size is reported in megawatts (or kilowatts) of deployments (i.e., interconnected and operational) by year and segment, as well as in U.S. dollars based on system price estimates and annual deployments (i.e., interconnection).

Given Seasonality, A Strong First Quarter for U.S. Energy Storage

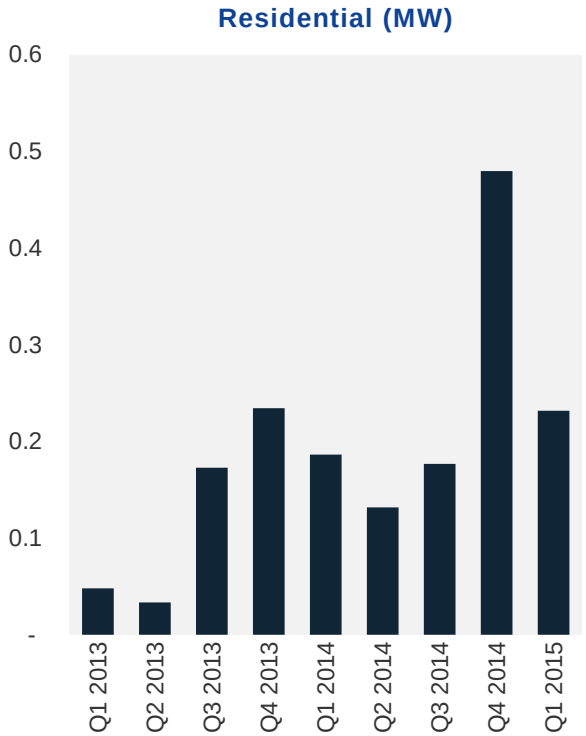


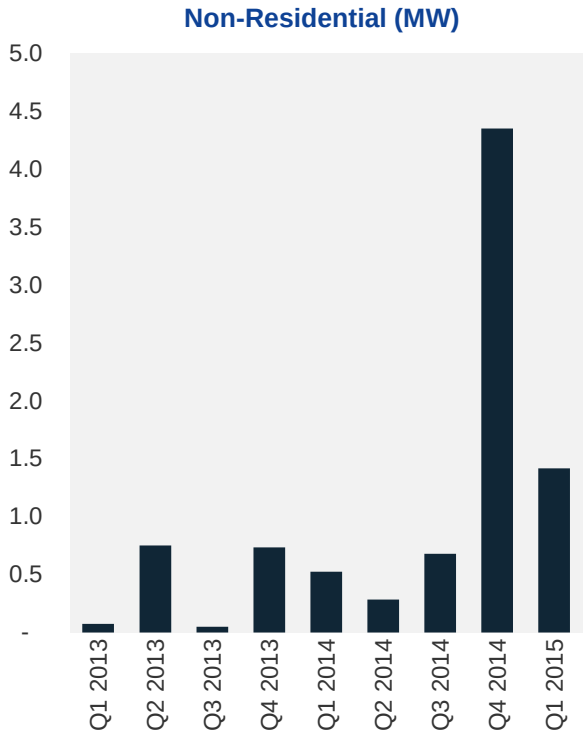


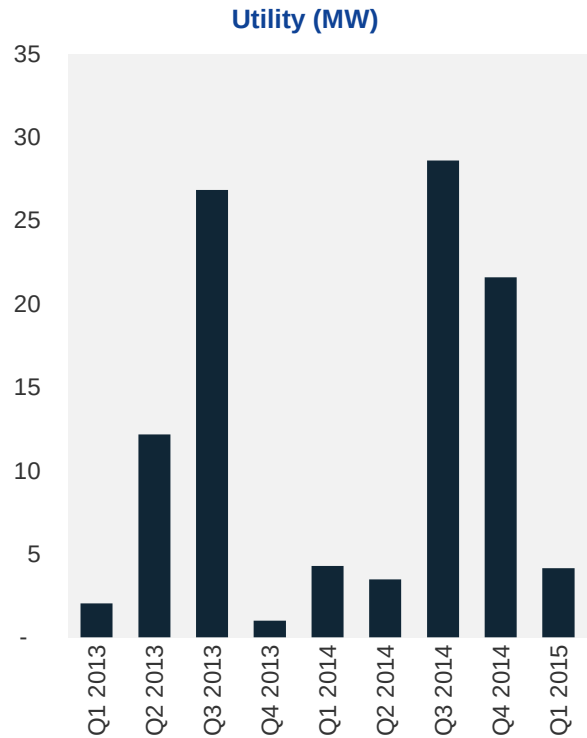


- The U.S. deployed 5.8 MW of energy storage in Q1 2015, up 16% over Q1 2014
- Behind-the-meter energy storage had its largest first quarter in history, with 1.6 MW of installations completed, up 132% over Q1 2014
- Utility-scale (front-of-meter) was the bigger of the two sectors, but installations comprised six small projects totaling 4.2 MW

Seasonal Effects Are Felt Across Market Segments







- After a big fourth quarter in 2014 across all three segments, deployments shrank in Q1 2015. However, seasonality played a significant role, and Q1 2015 was strong in all segments relative to previous first quarters.
- The residential market had its third-largest quarter ever in Q1 2015, while the non-residential market had its second-best showing.
- Market-specific deployment data is provided in the full report.

Top Energy Storage Markets' Cumulative Deployments Since Q1 2013

Rank	Residential	Deployments (kW)
1	California	1,016
2	Hawaii	320
3	Arizona	159

Rank	Non-Residential	Deployments (MW)
1	California	6.9
2	PJM (excl. NJ)	0.8
3	New Jersey	0.5

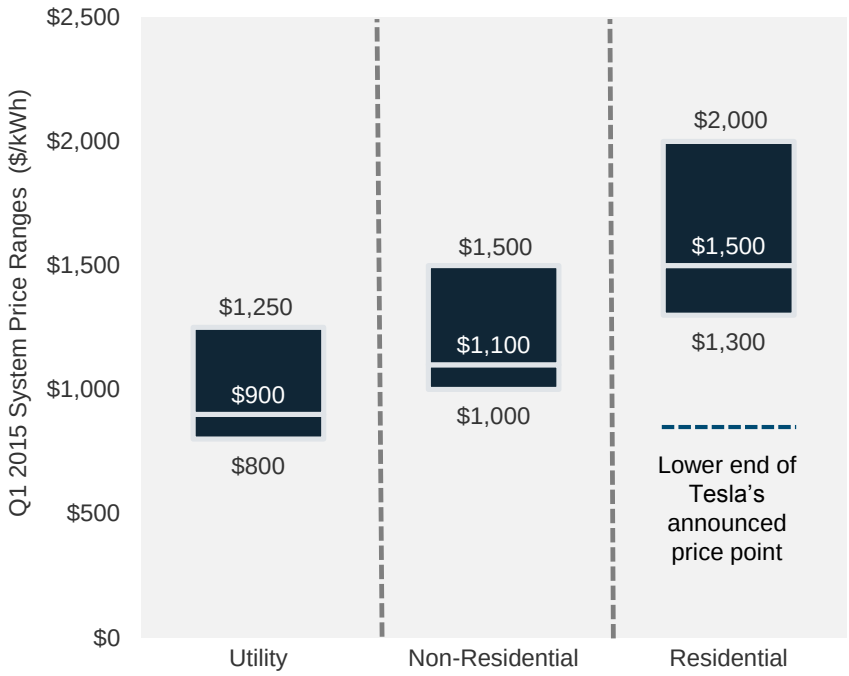
Rank	Utility	Deployments (MW)
1	PJM (excl. NJ)	68.7
2	California	21.2
3	All Others*	7.2

Rank	Total	Deployments (MW)
1	PJM (excl. NJ)	69.4
2	California	29.2
3	All Others*	7.8

- The U.S. energy storage market is still dominated by a handful of state markets, as the top two markets in each segment make up at least 79% of the total segment volume. PJM (excluding New Jersey) and California together have deployed 99 MW out of the total 115 MW deployed since Q1 2013 across all segments.
- PJM (excluding NJ) is the largest cumulative utility-scale market, with 68.7 MW since the beginning of 2013, followed by California at 21.2 MW and all other markets at 7.2 MW.
- California is the largest residential and non-residential market, with a cumulative 1.0 MW residential and 6.9 MW of non-residential energy storage.
- Hawaii is the second-largest residential market, with 320 kW of cumulative deployments; PJM (excluding New Jersey) comes in second in non-residential deployments with 0.8 MW.

* We are currently monitoring seven individual markets. Complete coverage of all markets is available in the full report.

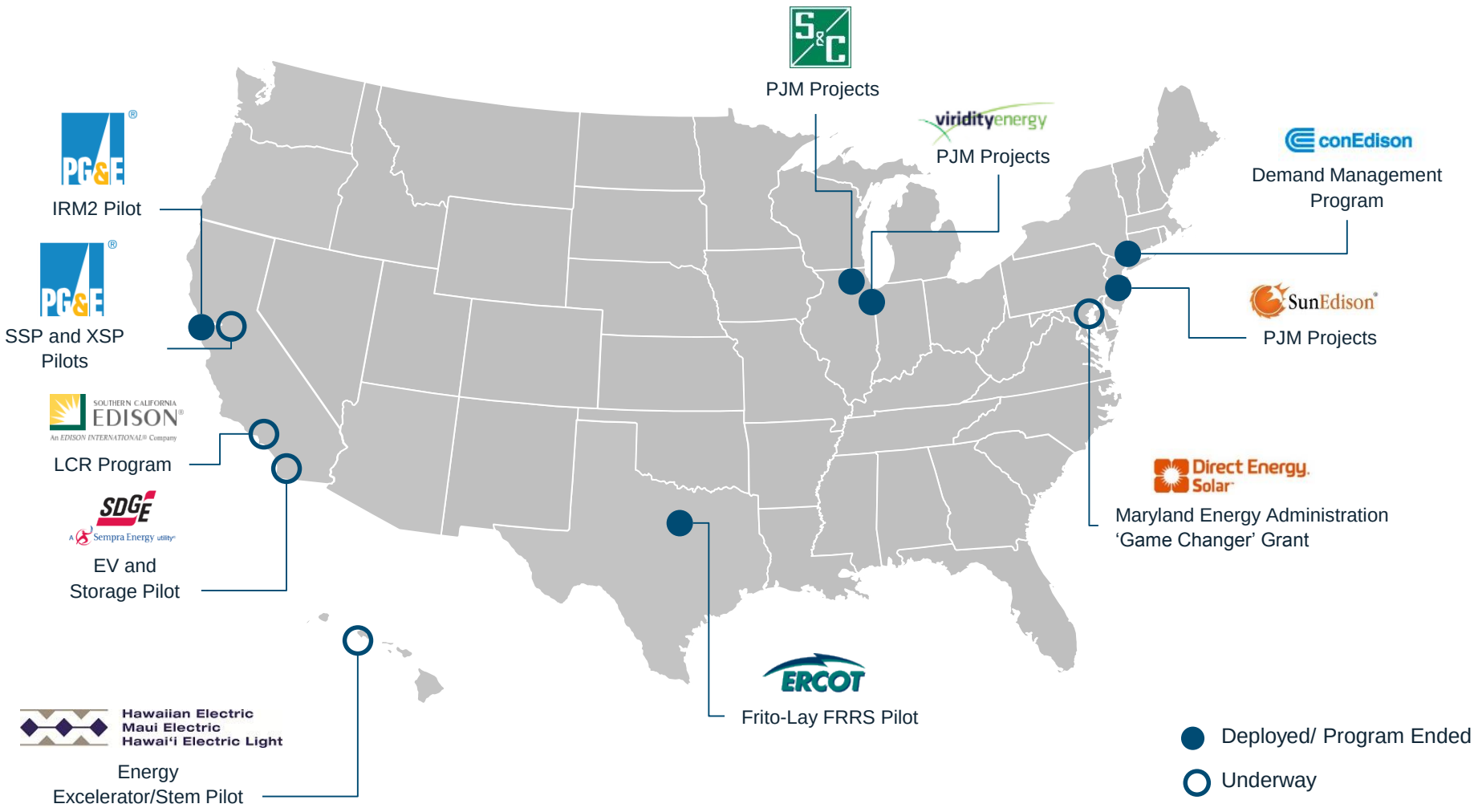
System Prices Continue to Decline



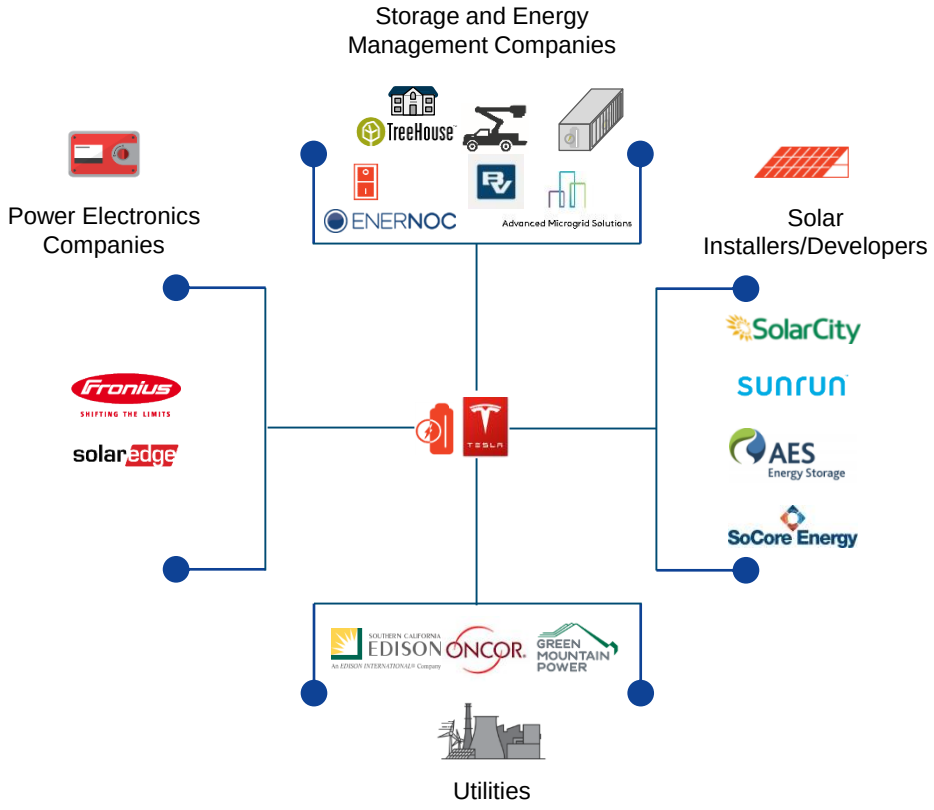
	Utility-Scale	Non-Residential	Residential
High	$1,250	$1,500	$2,000
Median	$900	$1,100	$1,500
Low	$800	$1,000	$1,300

- Keeping with the trend of years prior, system prices are continuing to see downward movement in 2015, driven by the following factors, enabled by higher deployment volumes:
  - Reduction in battery-pack costs, including batteries, wiring, racking and battery management systems
  - Improvements in system integration, required to get batteries running with the power conversion systems (PCS) and the grid
  - Reduction in balance-of-system costs, in part due to cost pressure from PCS vendors
- These prices are not associated with specific projects deployed in Q1 2015, since pricing data is considered sensitive by vendors and developers, given the number of projects that are being deployed and the varying project cycles. This system price data is instead estimated for projects deployed today based on the results of the bottom-up cost survey from eight interviews with vendors across the value chain, including battery vendors, system integrators and developers.
- All quoted prices are for systems using lithium-ion batteries with 1-2 hour discharge durations and without any special interconnection requirements.

Significant Early Activity in Behind-The-Meter Storage for Grid Services



Tesla Launch in Partnership with Storage Entrants and Veterans



Tesla announced an ecosystem of partnerships with solar installers, developers, vendors, channel partners and utilities

- In April 2015, Tesla launched its stationary storage product lines for residential and small commercial (Powerwall) and for large commercial and utility (Powerpack)

Products	Powerwall	Powerpack
System Size (kW and kWh)	2 kW continuous, 3.3 kW peak with 7 kWh and 10 kWh options	100 kWh blocks, 2-4 hours
Applications	10 kWh: Backup and peak management; 7 kWh: Daily cycling for time-shifting and backup	Peak demand reduction, capacity applications, grid market participation
DC battery price ($)	$3,500 for 10 kWh; $3,000 for 7 kWh	$250/kWh for utility-scale
System price, installed ($)	$7,140 for 10 kWh from SolarCity ($714/kWh for backup)	GTM Research estimate (at production scale): $700/kWh
Preorders (As announced on Q1 2015 earnings call)	38,000	2,500 of 100 kWh blocks

- Construction activity at Tesla's Nevada Giga factory will be the key bottleneck in Tesla's ability to fulfill these orders. Tesla expects to meet this demand by the middle of 2016. It is plausible that the $250/kWh is the target price point at full capacity utilization of production lines in Giga factory. This announcement puts price pressure on lithium-ion technology vendors, but won't result in drastic battery and system price reductions right away.

Front-of-the-Meter Policy and Market Developments, Q1 2015

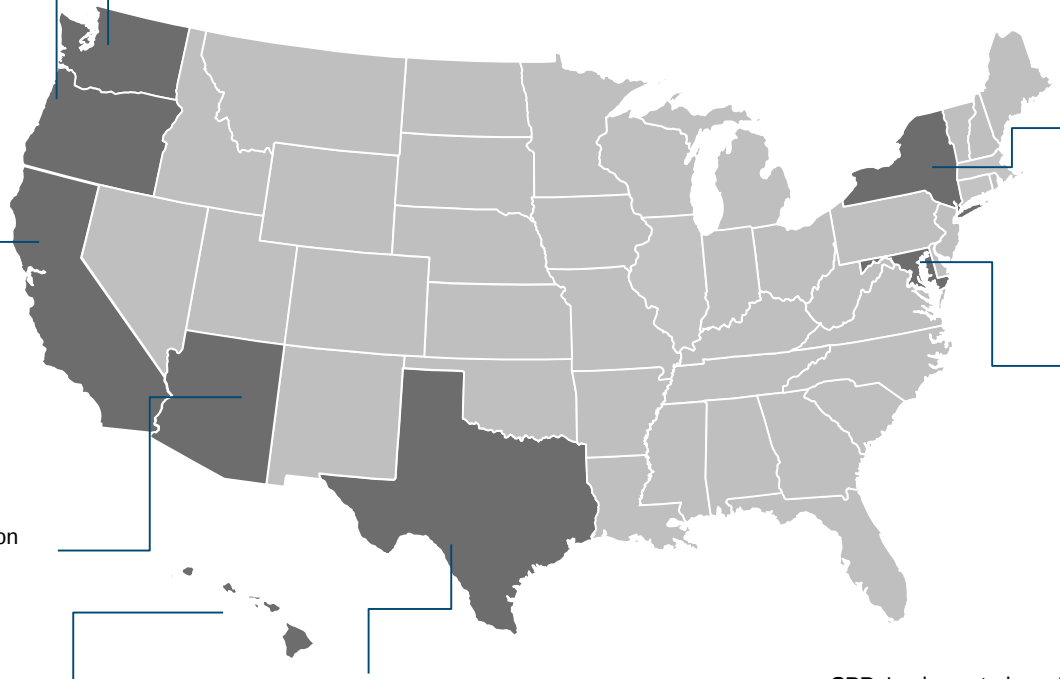
Oregon: Bill introduced to direct electric utilities to procure one or more 5 MW storage systems by 2020

Washington: Two of five **grant-funded projects** commissioned

U.S.: **FERC** proposed to permit the sale of primary frequency response service, distinct from regulation service, at market-based rates

ISO-NE: Introduced energy-neutral regulation signal and different parameter sets to track conventional and energy-neutral dispatched resources

California: **CPUC** issued final guidance for distributed resource plans to be filed in July 2015; also instituted rulemaking addressing energy storage procurement framework and Storage Roadmap recommendations; **CAISO** reduced performance threshold for frequency regulation



New York: **Con Edison** procuring storage for T&D deferral; **New York PSC** will allow utility ownership of distribution-integrated storage under REV initiative

Maryland: Bill introduced to require the **PSC** to establish a pilot program for systems storing energy from resources including solar and wind

Arizona: **TEP** issued solicitation for 10 MW storage system

Hawaii: Several bills introduced to establish tax credits for grid-connected storage systems

Texas: Bill introduced to make large-scale electric energy storage eligible for tax benefits; no bills introduced in support of **Oncor's** proposal to deploy utility-controlled distributed energy storage

SPP: Implemented pay-for-performance compensation for frequency regulation

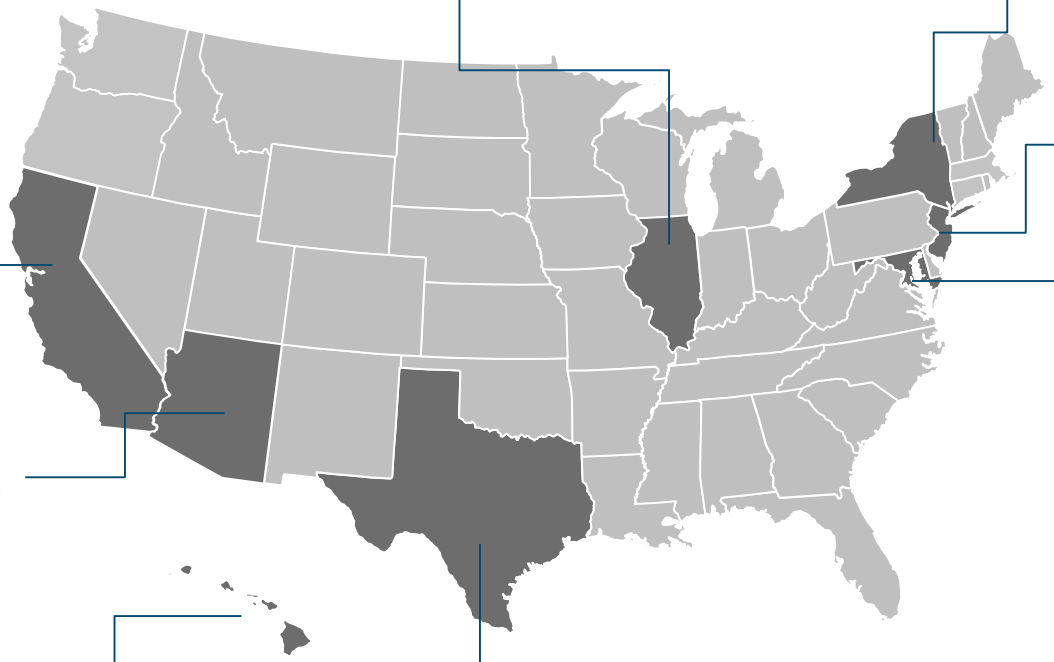
PJM: Delayed May 2015 Base Residual Auction in response to FERC deficiency notice regarding Capacity Performance filing

Behind-the-Meter Policy and Market Developments, Q1 2015

Illinois: Bill introduced to enable **ComEd** to invest $300 million in six microgrids

New York: **Con Edison** has contracted for over 2 MW of behind-the-meter battery storage; **NYSERDA** accepting proposals for community microgrid feasibility studies (NY Prize)

California: **CPUC's** SGIP program has provided upfront incentives to 6.8 MW of behind-the-meter storage and reserved funding for an additional 85.5 MW



New Jersey: **BPU** awarded $2.9 million to 13 storage projects totaling 8.75 MW paired with renewable generation

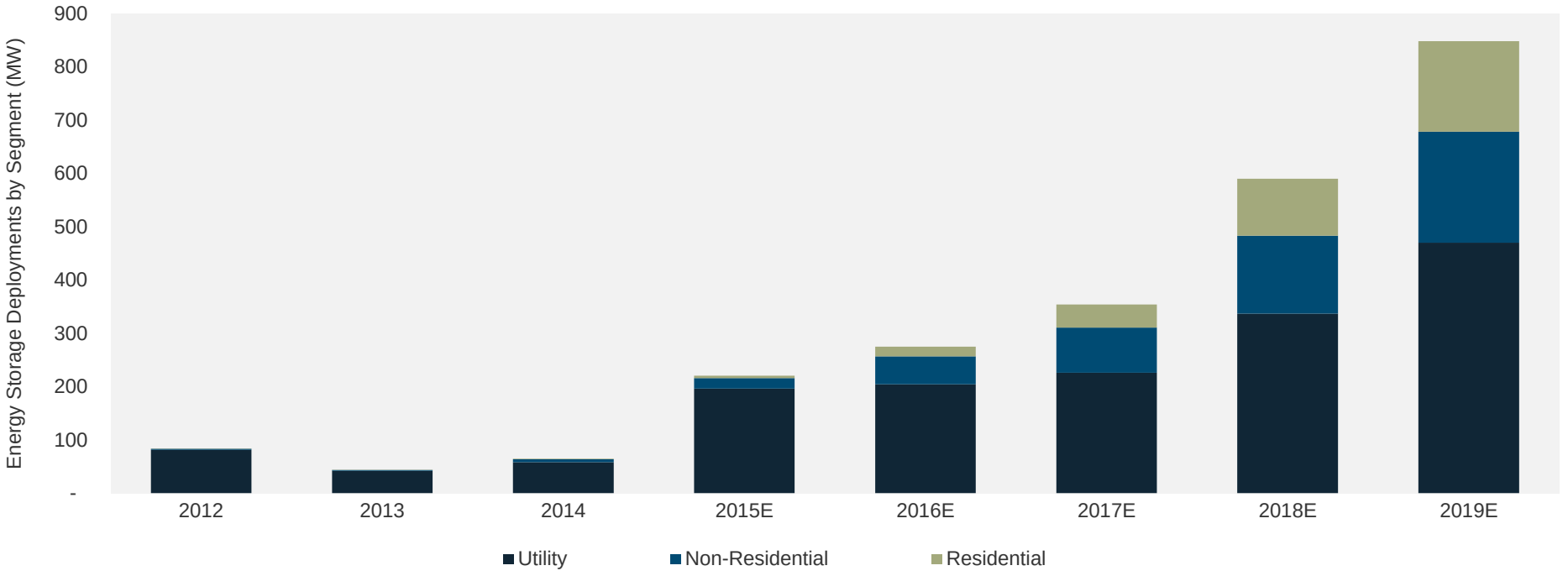
Maryland: **Energy Administration** currently reviewing applications for projects demonstrating dynamic energy control involving technologies including energy storage

Arizona: **APS** to deploy up to 2 MW of distributed solar-plus-storage; also providing up to $1 million in rebates for solar-plus-storage pilot program, in addition to potential residential non-volumetric charges that could impact storage

Hawaii: Several bills introduced to establish tax credits for grid-connected and off-grid storage systems; **PUC** ordered Hawaiian Electric to streamline interconnection requirements for customer-sited energy storage

Texas: **ERCOT** looking at DER participation in wholesale markets; no bills introduced in support of **Oncor's** proposal to deploy utility-controlled distributed energy storage

Significant Growth Expected Across Segments in 2015



- GTM Research expects significant growth in the U.S. energy storage market over the next five years across all sectors, resulting in an 848 MW annual market in 2019 – 13 times the size of the 2014 market and four times the size of the 2015 market.
- 2015 will see particularly rapid growth, with 220 MW deployed and each segment more than doubling on an annual basis, with a further upside in the non-residential segment.
- Forecast details by market and segments are provided in the full report.

U.S. Energy Storage Monitor

Produced in a collaboration between GTM Research and the Energy Storage Association (ESA), the *U.S. Energy Storage Monitor* is the industry's only comprehensive, quarterly research report on energy storage markets, deployments, policies, financing and regulations in the U.S. The report is available for purchase quarterly or as an annual subscription.

Executive Summary vs. Full Report Content

Content	Executive Summary	Full Report
Energy Storage Deployments	National Aggregate	By State and Market Segment
Deployments by Technology	Not Available	Available
Market Trends	National Highlights	Detailed Analysis
Pricing Data	Not Available	Quarterly Index
Deployment Forecast	National Aggregate	By State and Segment

Report Pricing

Member Status	Executive Summary	Full Report (PDF Enterprise License)	
		Individual Quarterly Report	Annual Subscription-4 reports
ESA Members	Free	$1,500	$5,000
Non-ESA Members		$2,500	$8,000

This report is relevant to:

- Technology Firms
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- System Integrators
- Third-Party Financiers
- Project Developers
- Utilities and IPPs
- Universities
- Policymakers and Regulators

For more information, contact Tate Ishimuro at ishimuro@gtmresearch.com or visit www.energystoragemonitor.com