



U.S. DEPARTMENT OF
ENERGY



Sandia
National
Laboratories

Energy Storage Technology Advancement Partnership
(ESTAP) Webinar:

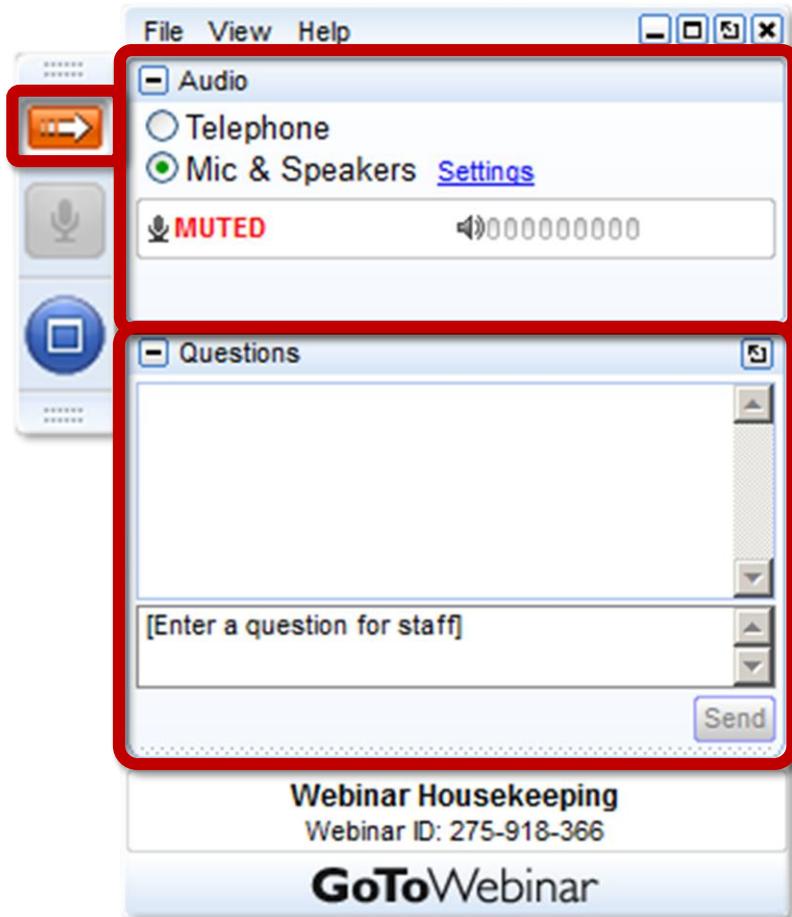
State of the U.S. Energy Storage Industry: 2017 Year in Review

February 13, 2018



CleanEnergy
States Alliance

Housekeeping



Use the red arrow to open and close your control panel

Join audio:

- Choose Mic & Speakers to use VoIP
- Choose Telephone and dial using the information provided

Submit questions and comments via the Questions panel

This webinar is being recorded. We will email you a webinar recording within 48 hours. CESA's webinars are archived at www.cesa.org/webinars

Celebrating 15 Years of State Leadership

Clean Energy States Alliance



Illinois Department of Commerce & Economic Opportunity



NYSERDA



Office of the People's Counsel
District of Columbia
Advocating, Protecting and Educating DC Consumers



Energy Storage Technology Advancement Partnership (ESTAP)

ESTAP is supported by the U.S. Department of Energy Office of Electricity and Sandia National Laboratories, and is managed by CESA.

ESTAP key activities:

- 1) Disseminate information to stakeholders through:
 - The ESTAP listserv (>4,000 members)
 - Webinars, conferences, information updates, surveys
- 2) Facilitate public/private partnerships at the state level to support energy storage demonstration project development.
- 3) Support state energy storage efforts with technical, policy and program assistance

Thank You:

Dr. Imre Gyuk

U.S. Department of Energy, Office of Electricity Delivery and Energy Reliability

Dan Borneo

Sandia National Laboratories



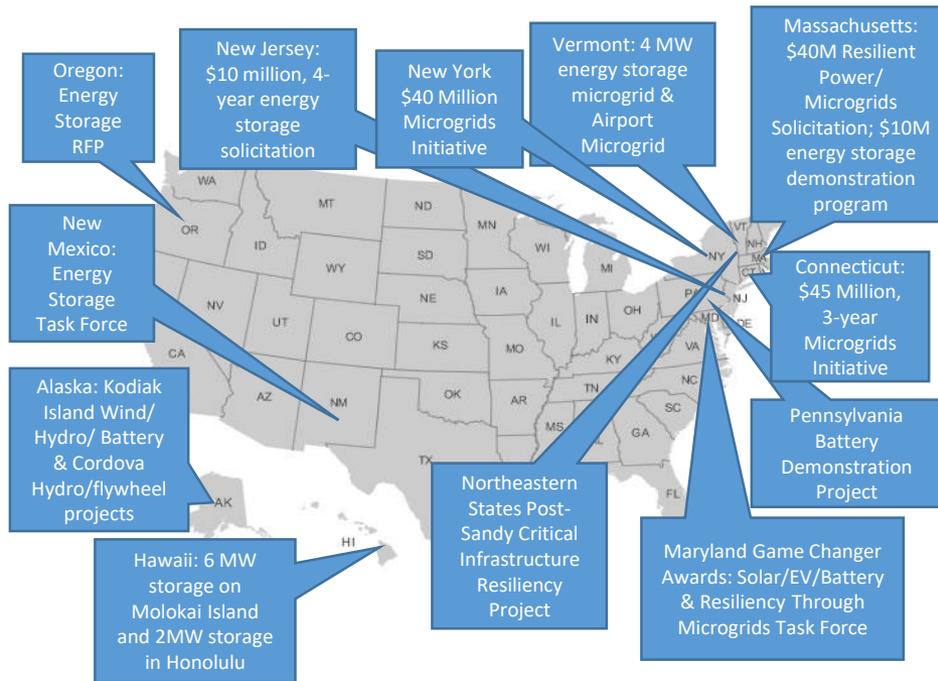
U.S. DEPARTMENT OF
ENERGY



Sandia
National
Laboratories



CleanEnergy
States Alliance



State of the U.S. Energy Storage Industry: 2017 Year in Review

- **Dr. Imre Gyuk**, Director of Energy Storage Research, U.S. Department of Energy - Office of Electricity Delivery and Energy Reliability
- **Dan Finn-Foley**, Senior Analyst, Energy Storage, GTM Research
- **Todd Olinsky-Paul**, Project Director, Clean Energy States Alliance (Moderator)



Energy Storage Micro-grids: Monetizing Resilience, Through New Business Cases!

IMRE GYUK, DIRECTOR,
ENERGY STORAGE RESEARCH, DOE-OE

The Growing Need for Resilience



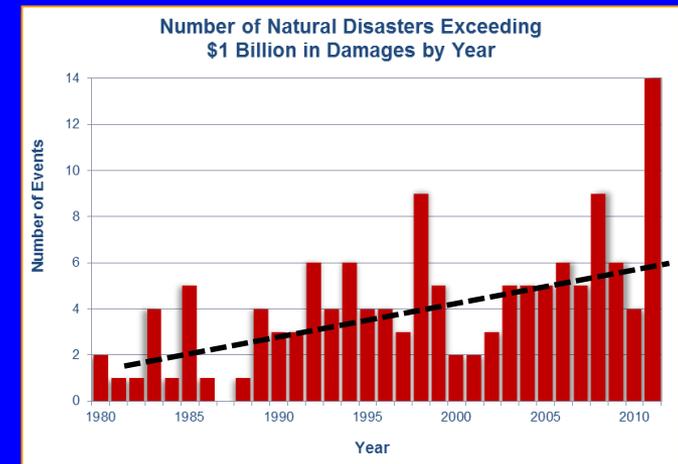
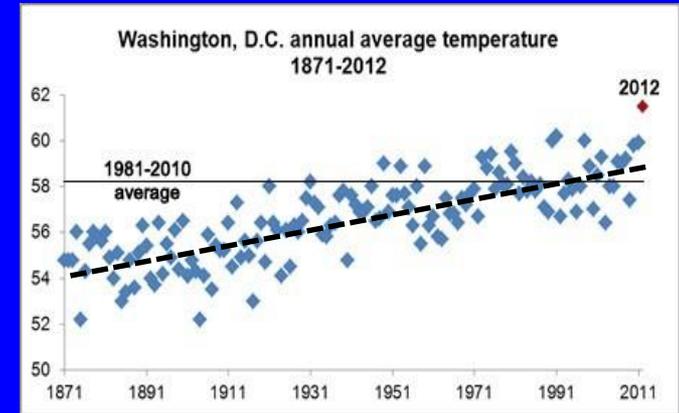
Florida, Harvey, 2017



Puerto Rico, Maria 2017



Mexico 2017



Every \$1 on protection measures can prevent \$4 in repairs after a storm!

Trends indicate the situation will get worse not better!!

Storage Economics:



The **Cost** of a Storage System depends on the Storage Device, the Power Electronics, and the Balance of Plant



The **Value** of a Storage System depends on Multiple Benefit Streams, both monetized and unmonetized

Metrics will depend on locality!

Power Electronics
20-25%

Energy Storage Device
25-50%

Facility 20-25%

Arbitrage

Frequ. Reg.

Dem. Charges
month, year

Resiliency

Values such as Resiliency, Military Energy Assurance, or Emergency Preparedness are difficult to Monetize, yet they are often the primary Reason for a Project.

Microgrids with Renewables and Storage are a good Solution for Resiliency.

But the Business case of a project must rest on Monetizable Benefit Streams.

Sterling, MA: Microgrid/Storage Project



Sterling, MA, October 2016



Sterling, MA, December 2016

Sterling Municipal Light Department.

\$1.5M Grant from MA Community Clean Energy Resiliency Initiative (Dept. of Energy Resources). DOE/Sandia. Clean Energy Group.

2MW/2hr storage with existing 3.4 MW PV to provide **resiliency** for Police HQ and Dispatch Center. Li-ion batteries provided by NEC.

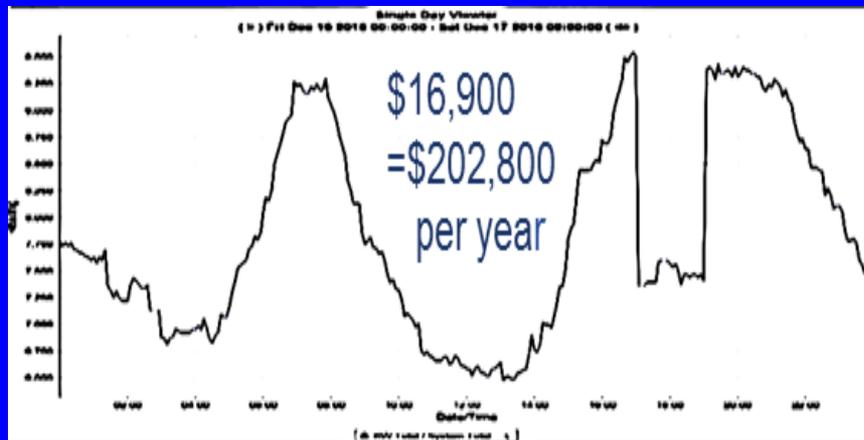
Storage Economics in Action.

Using what we learned in Vermont!

Description (1MW/1hr)	\$
Arbitrage (buy low, sell high)	13,321
Reduced Monthly Peak	98,707
Reduced Yearly Peak	115,572
Frequency Regulation	60,476
Total	288,076

Capital cost: \$1.77M/MW,
calc. potential benefits.
Simple payback: 6.7 years

Analysis by Ray Byrne, Sandia

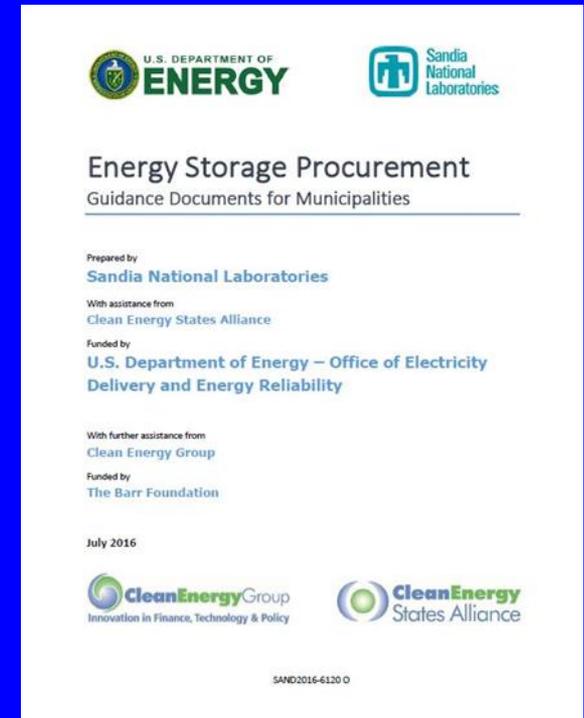


2016 Dec. till 2017 Nov. Actual Savings:

- Arbitrage \$11,731
- Monthly Peaks \$143,447
- Annual Peak \$240,660
- Total \$395,839

Energy Storage Procurement, Guidance Document for Municipalities Dan Borneo (Sandia)

Specific examples of the elements that should be included in a solicitation for the procurement and installation of a battery energy storage project designed to provide backup power during outages and facilitate timely cost recovery.



www.sandia.gov/ess
SAND 2016-8544

2017 GTM Grid Edge Award!

Visitors: Germany, Denmark, England, Japan, Malaysia, Taiwan

Massachusetts Follow on Activities:

- MA adopts 200 MWh utility energy storage procurement target
- Sterling Community Project: solar + storage
2 MWh energy storage with 1 MW community solar
- 7 more MA municipal utilities have resiliency grants with storage
- MMWEC, which serves 42 municipal utilities in MA, proposes centralized operation and dispatch services

With every successful Project
the Value Propositions will
continue to gain Strength!

But to do this
we need inclusive Cost Data
and honest Accounting of
actually realized Benefits.

State of the U.S. Energy Storage Industry: 2017 Year in Review

Prepared for:



gtmresearch
is now Wood Mackenzie

Daniel Finn-Foley – Senior Analyst, Energy Storage

February 2018

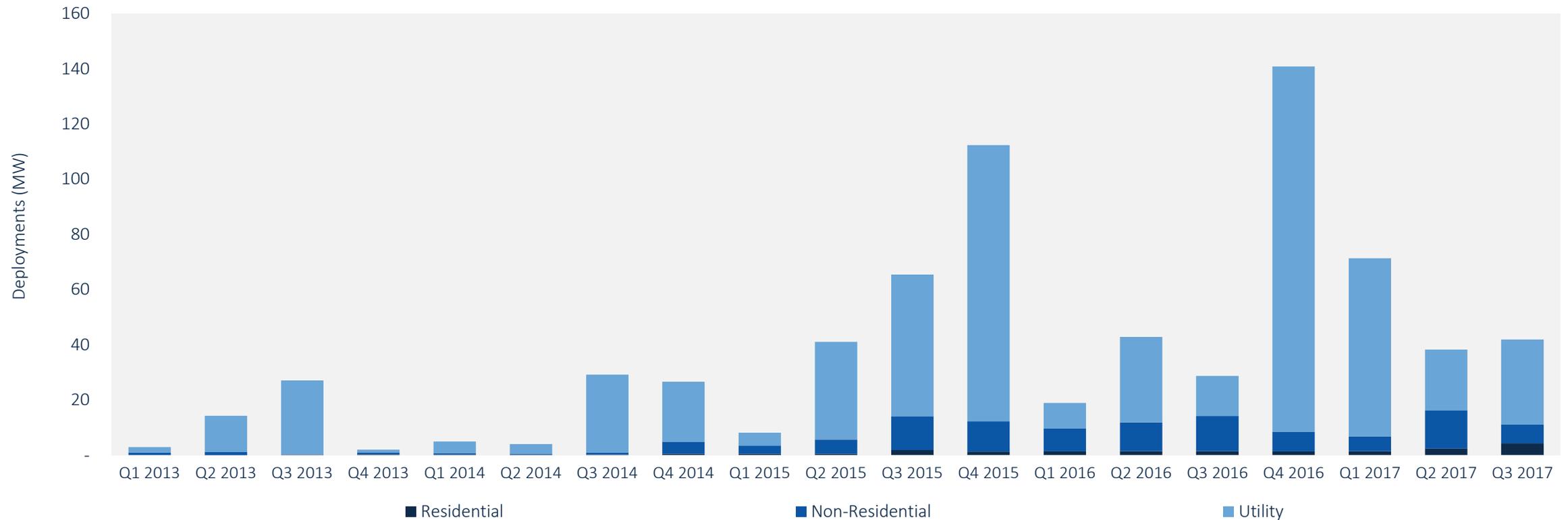
gtmresearch
is now Wood Mackenzie

1. Deployment Trends	2
2. Market Drivers	10
3. Outlook	16

1. Deployment Trends

U.S. Q3 2017 Deployments in Megawatts Up 46% Over Previous Year

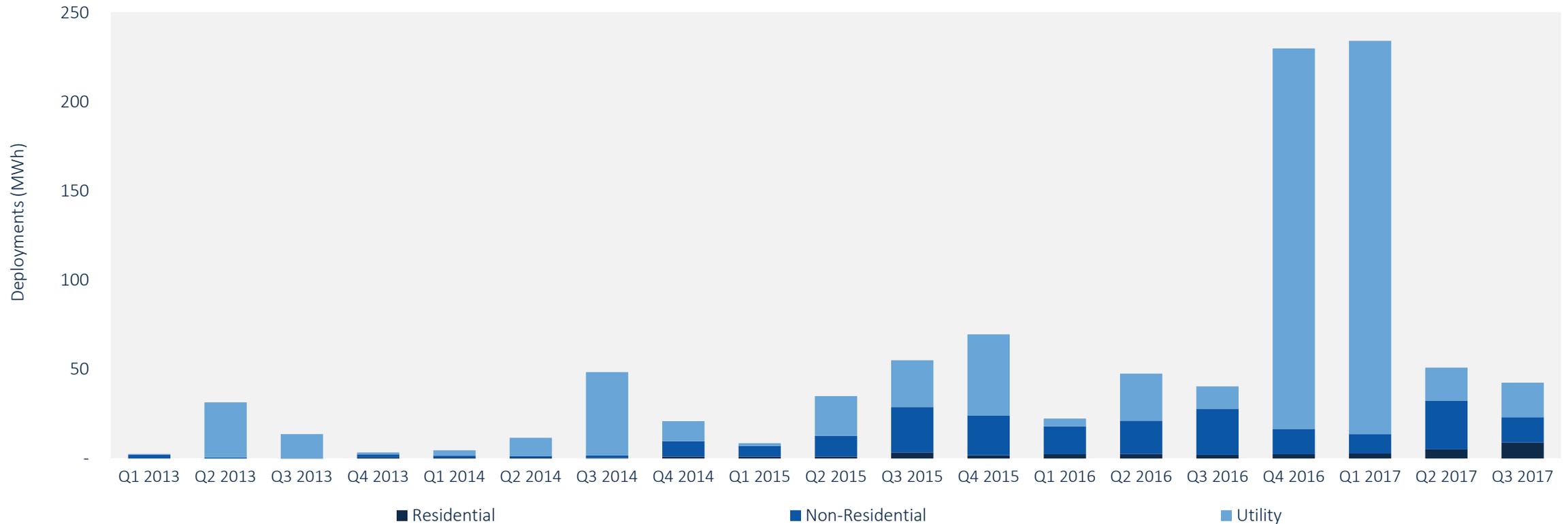
U.S. Quarterly Energy Storage Deployments by Segment (MW)



Source: GTM Research

U.S. Q3 2017 Deployments in Megawatt-Hours Up 5% Over Previous Year

U.S. Quarterly Energy Storage Deployments by Segment (MWh)



Source: GTM Research

Top Energy Storage Markets, Q3 2017: Texas Leads Utility-Scale, California Dominates BTM

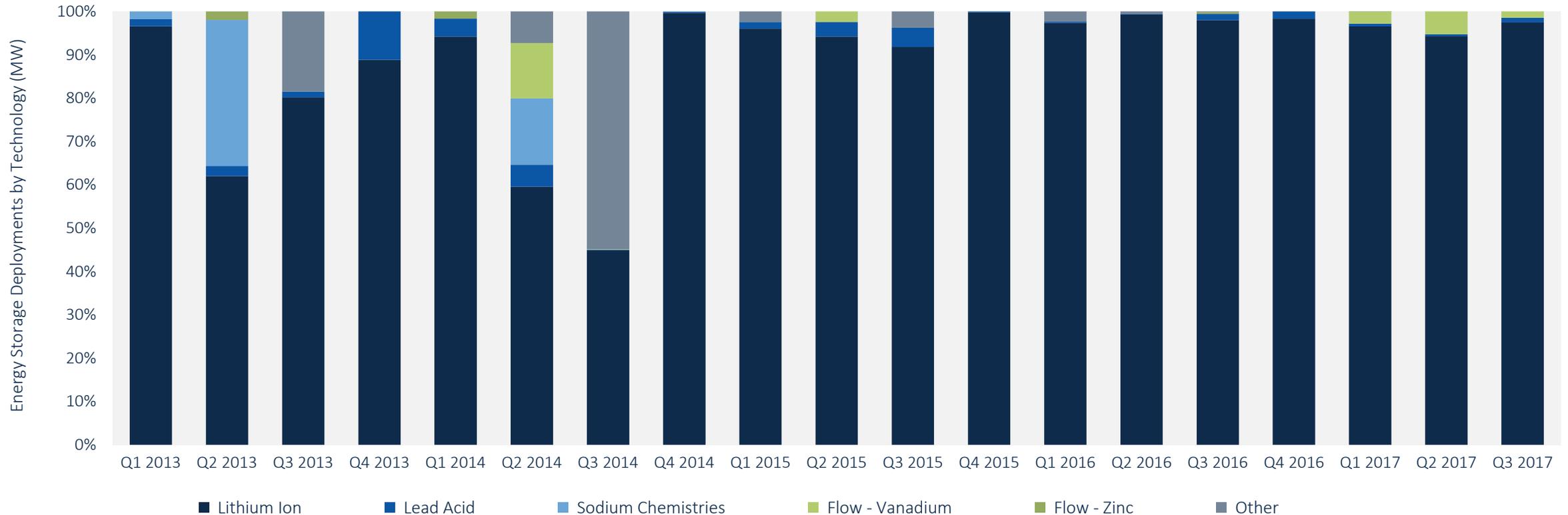
Top 3 Markets by Segment in Q3 2017 (Power Capacity)

Rank	Residential	Non-Residential	Utility
1	California	California	Texas
2	Hawaii	All Others*	Massachusetts
3	All Others*	Hawaii	All Others*

*GTM Research is currently monitoring eight individual markets. Complete coverage of all markets is available in the full report.

Lithium-Ion Technology Continues the Trend of More Than 94% Share

Quarterly Energy Storage Deployment Share by Technology (MW %)

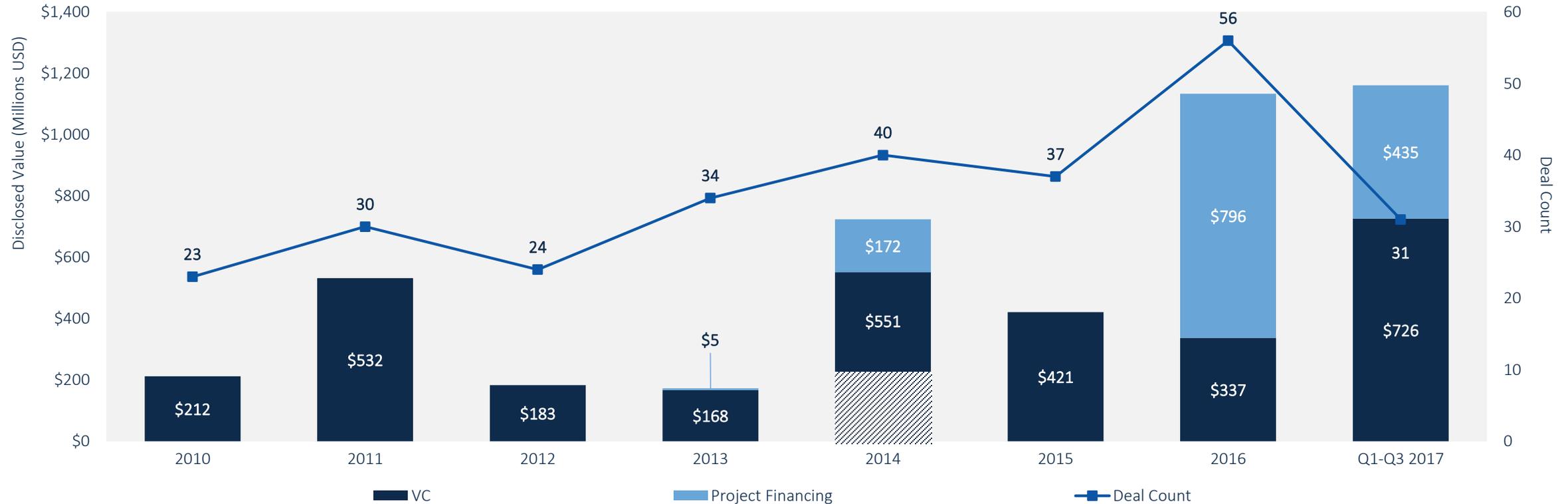


Source: GTM Research

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

Corporate Investments in Energy Storage Reached \$110M in Q3 2017

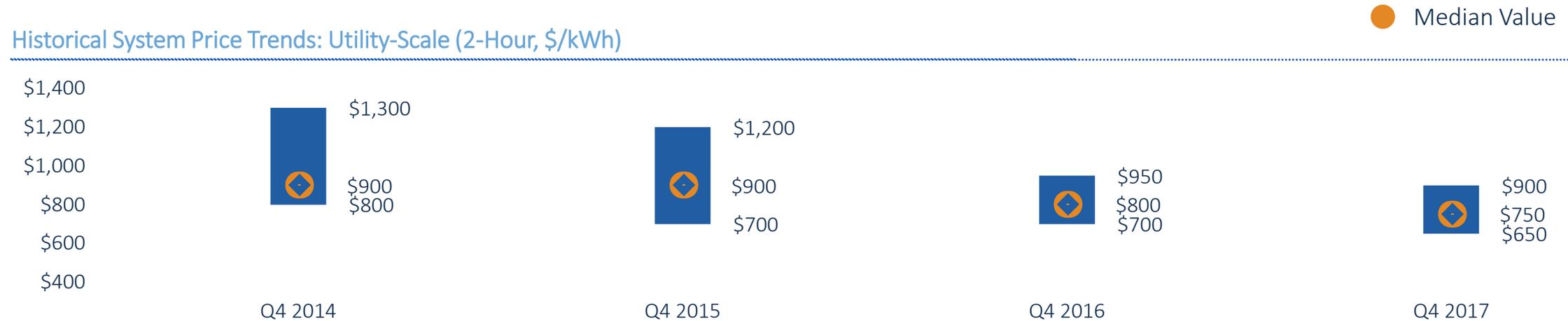
Disclosed Corporate Investments in Energy Storage, 2010-Q3 2017 (Million \$, Number of Deals)



Source: GTM Research

Note: The total disclosed investment in 2014 was boosted by a rumored \$250 million investment in Boston-Power (shaded in the figure above); Data excludes battery materials and upstream companies. 2014 data differs from *U.S. Energy Storage Monitor 2014 Year in Review* due to exclusion of EV startup Atieva and inclusion of stealth startup Fluidic Energy.

Historical System Price Trends: Front-of-the-Meter Prices Down 3% to 9% Year-Over-Year



Source: GTM Research

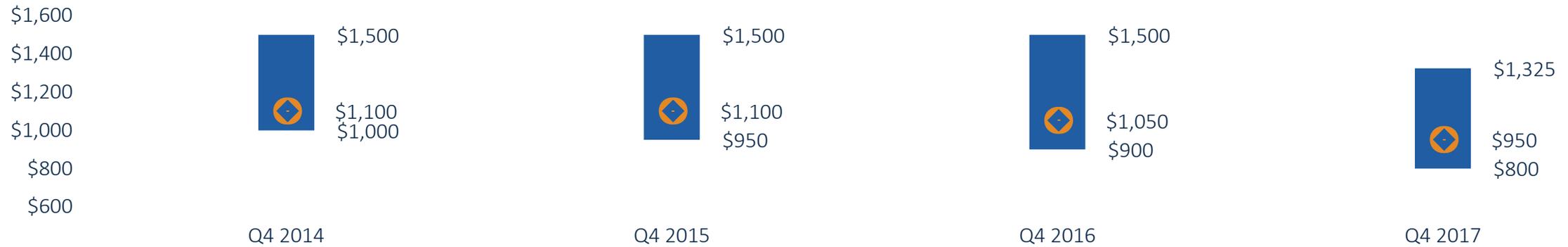
Historical System Price Trends: Utility-Scale (30-Minute, \$/kW)



Source: GTM Research

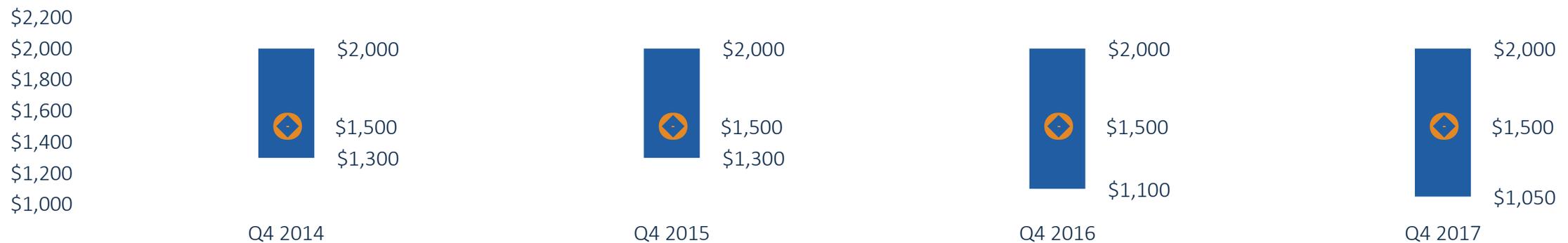
Historical System Price Trends: Behind-the-Meter Non-Residential Continues Downward Slide

Historical System Price Trends: Non-Residential (\$/kWh)



Source: GTM Research

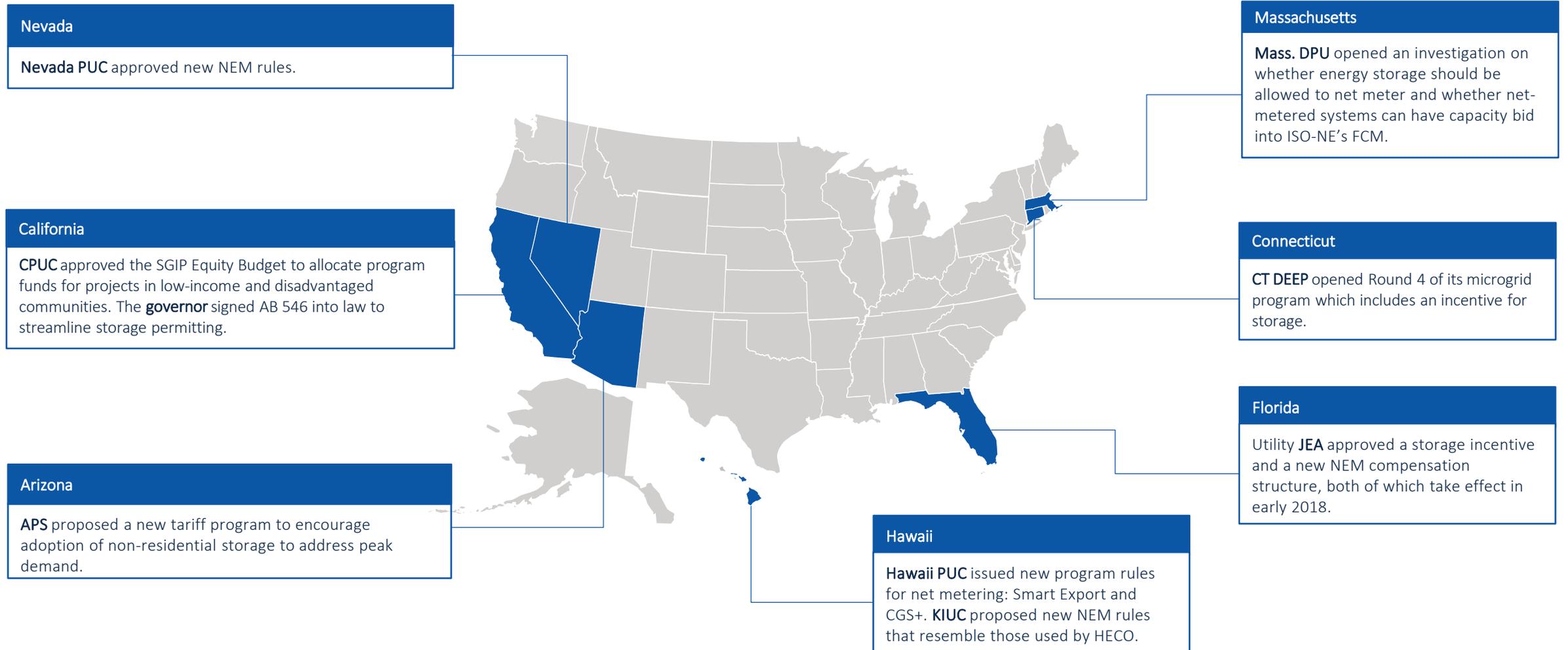
Historical System Price Trends: Residential (\$/kWh)



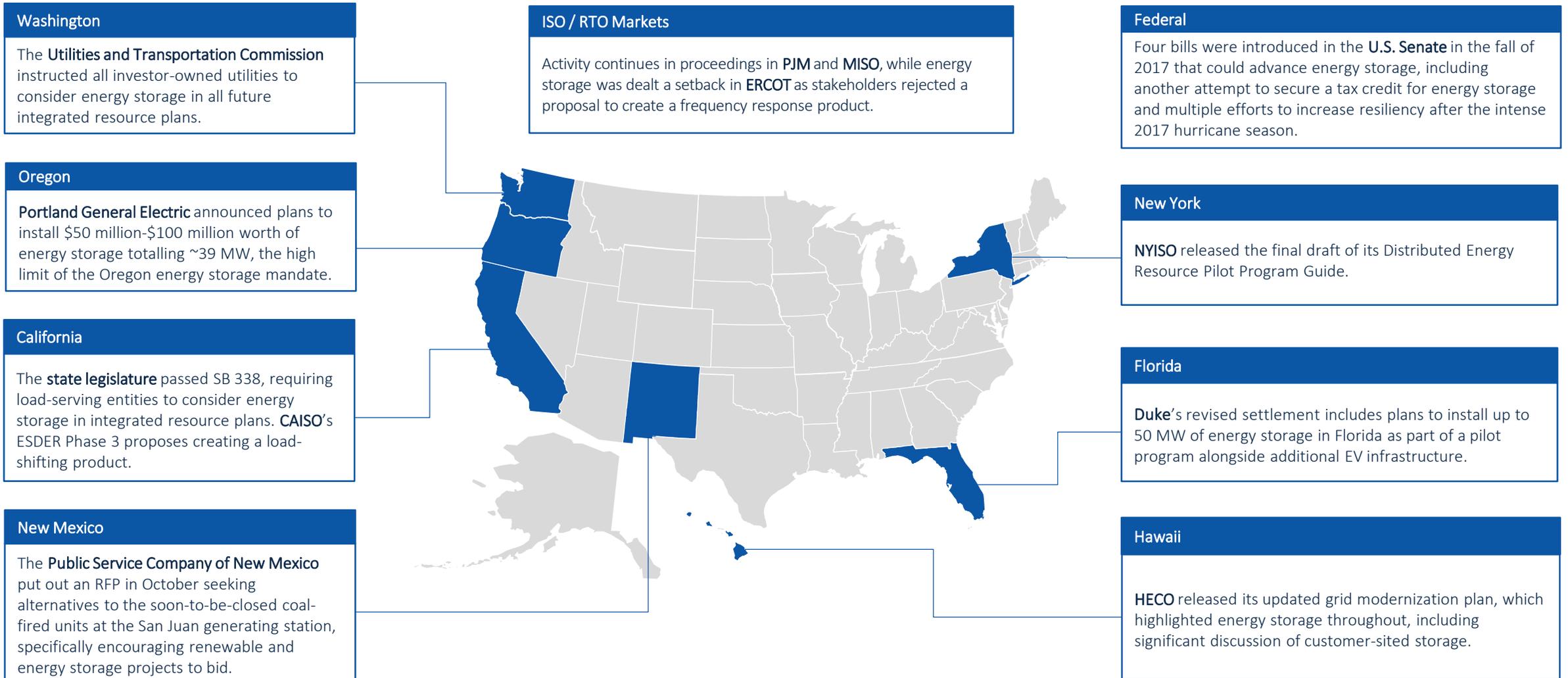
Source: GTM Research

2. Market Drivers

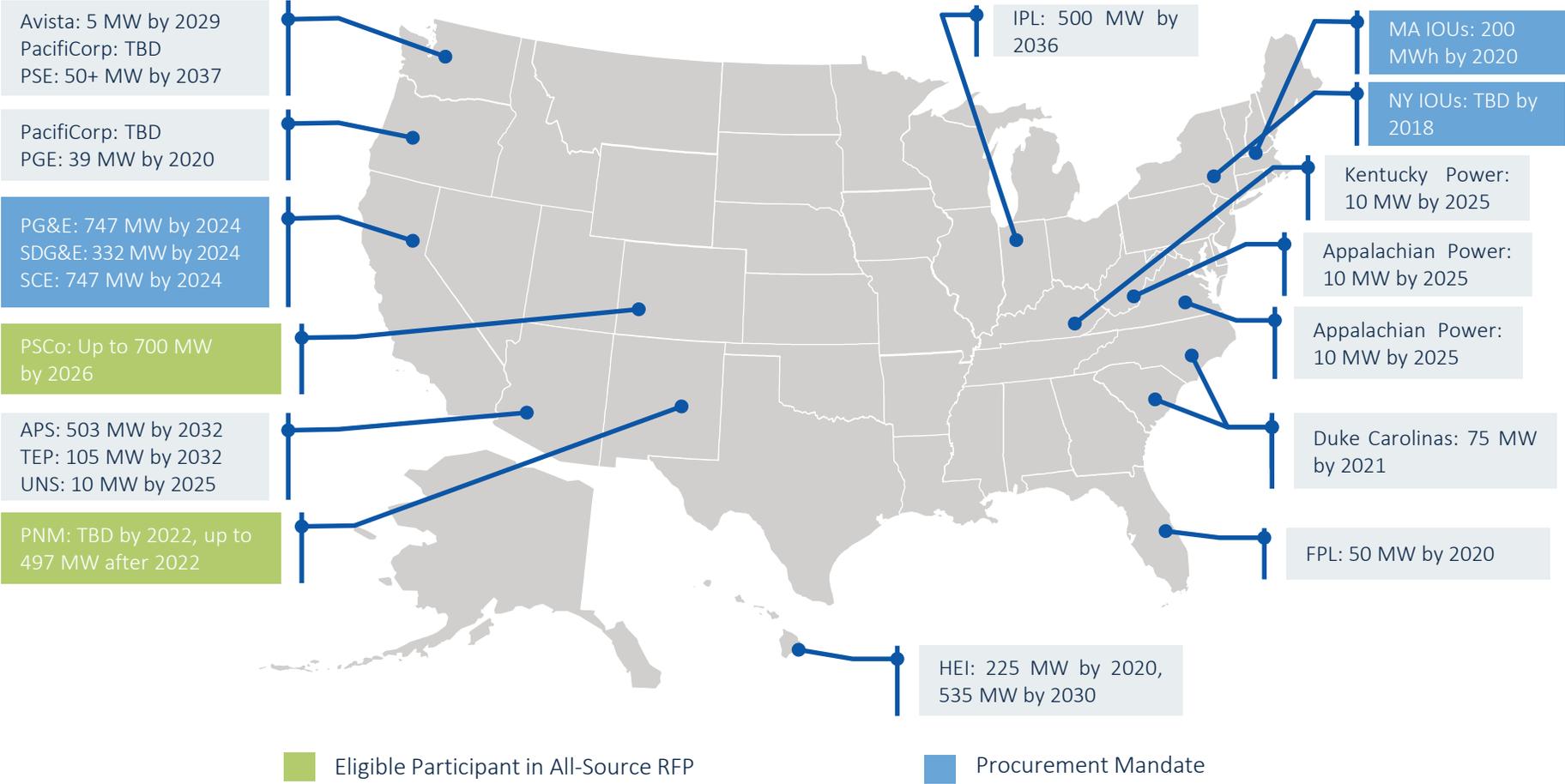
Behind-the-Meter Policy and Market Developments, Q4 2017



Front-of-the-Meter Policy and Market Developments, Q4 2017



Almost 2 GW of Storage Modeled in Utilities' IRPs; More Storage Eligible in RFPs and Mandates



Source: GTM Research

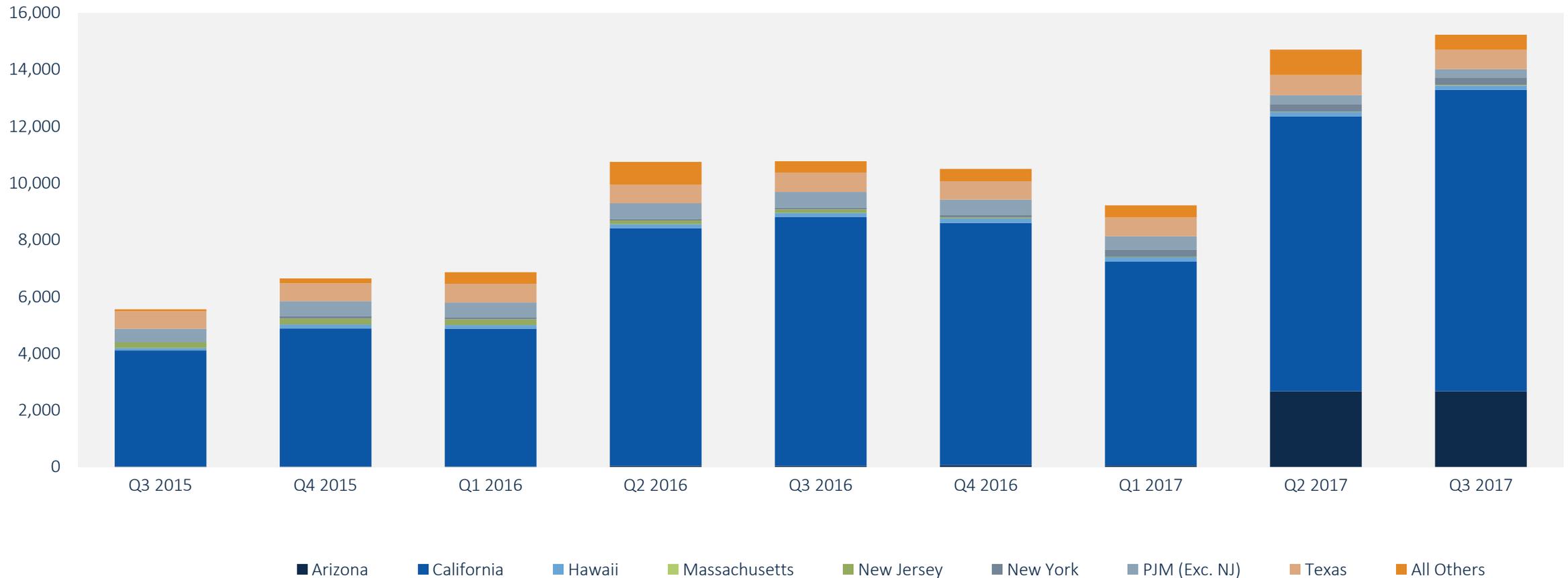
2017 Experienced Significant Energy Storage M&A Activity



3. Outlook

California Pipeline Grows; Other ISOs See Their Interconnection Queues Shrink

U.S. Utility-Scale Energy Storage Pipeline by Market, Q3 2015-Q3 2017 (MW)



Source: GTM Research

U.S. Energy Storage Annual Deployments Will Reach 2.5 GW by 2022

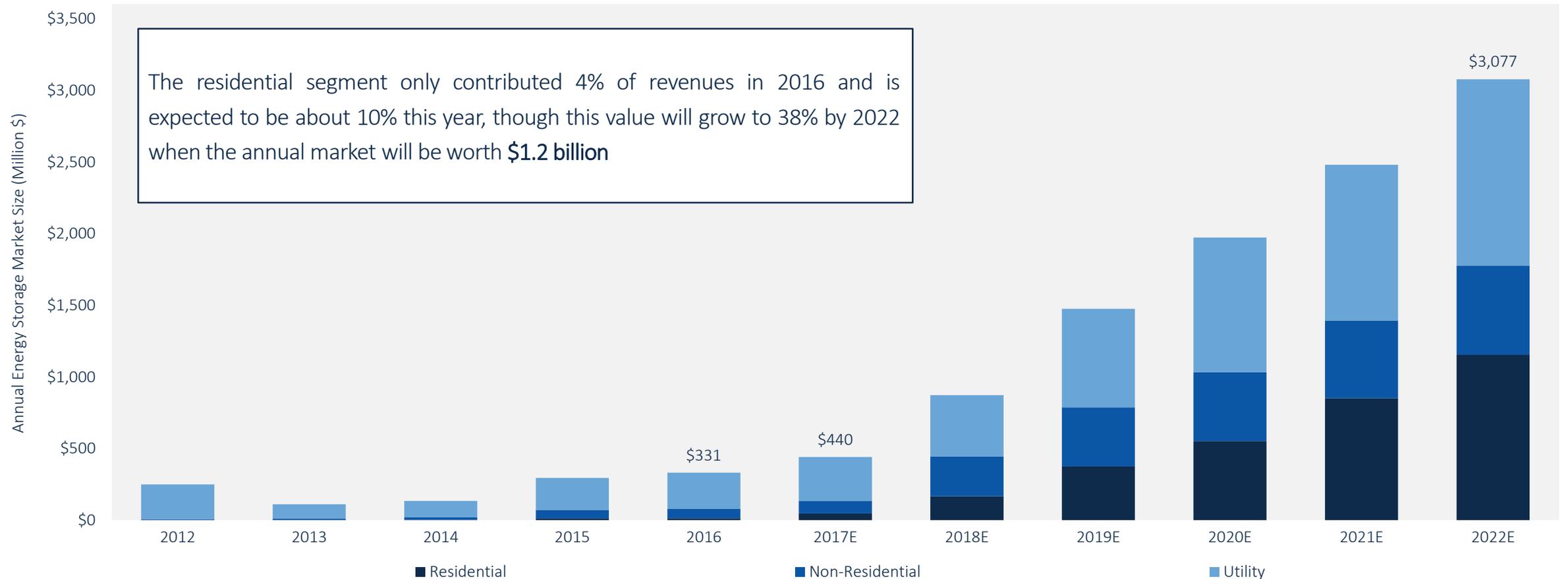
U.S. Annual Energy Storage Deployment Forecast, 2012-2022E (MW)



Source: GTM Research

Energy Storage Will Be a \$3.1 Billion Market by 2022

U.S. Annual Energy Storage Market Size, 2012-2022E (Million \$)



Source: GTM Research

Contents (Full Report)

1. Introduction and Key Findings	5
2. Energy Storage Market Overview	8
3. Energy Storage in Integrated Resource Plans	38
4. Utility-Scale Market Trends	46
5. Behind-the-Meter Market Trends	62
6. Non-Residential Market Trends	67
7. Residential Market Trends	76
8. Appendices	87

Thank you!

Daniel Finn-Foley

Senior Analyst, Energy Storage

finn-foley@gtmresearch.com

Interested in other GTM Research products and services? Please visit www.gtmresearch.com or contact sales@greentechmedia.com

February 2018

gtmresearch
is now Wood Mackenzie

Contact Info

CESA Project Director:

Todd Olinsky-Paul

(Todd@cleanegroup.org)

Sandia Project Director:

Dan Borneo

(drborne@sandia.gov)

Webinar Archive:

www.cesa.org/webinars

ESTAP Website: bit.ly/CESA-ESTAP

ESTAP Listserv:

bit.ly/EnergyStorageList



Upcoming Webinars

Solar+Storage for Public and Affordable Housing

Thursday, February 22, 1-2pm ET

One Year In – Energy Storage Proves its Worth in Sterling, MA

Wednesday, March 7, 1-2pm ET

Valuing Resilience: Exploring the Role of Solar+Storage in Grid Outages

Wednesday, March 14, 1-2pm ET

Read more and register at

www.cesa.org/webinars