



Energy Storage Technology Advancement Partnership (ESTAP) Webinar:

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

February 13, 2018



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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



Task Force

Alaska: Kodiak Island Wind/

Hydro/ Battery

& Cordova Hydro/flywheel

Hawaii: 6 MW

storage on

Molokai Island

and 2MW storage

in Honolulu



New York

\$40 Million

Microgrids

Sandy Critical

Resiliency

\$10 million, 4-

year energy

energy storage

microgrid &



Maryland Game Changer

Awards: Solar/EV/Battery

& Resiliency Through

Microgrids Task Force

Massachusetts:

\$40M Resilient

Solicitation; \$10M energy storage

demonstration

\$45 Million, 3-year

Battery



Sandia National Laboratories



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)







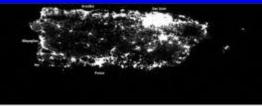
Energy Storage Micro-grids: Monetizing Resilience, Through New Business Cases!

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

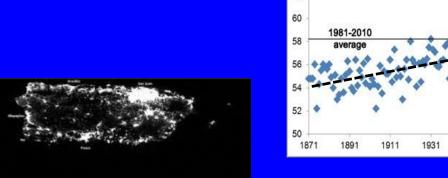
The Growing Need for Resilience

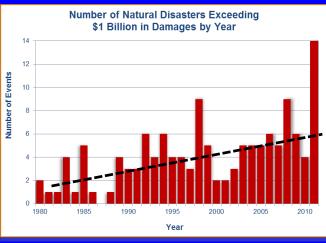


Florida, Harvey, 2017



Puerto Rico, Maria 2017





Washington, D.C. annual average temperature 1871-2012

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

Power Electronics 20-25%

Energy Storage Device 25-50%

Facility 20-25%

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

Arbitrage

Frequ. Reg.

Dem. Charges month, year

Resiliency

Metrics will depend on locality!

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.

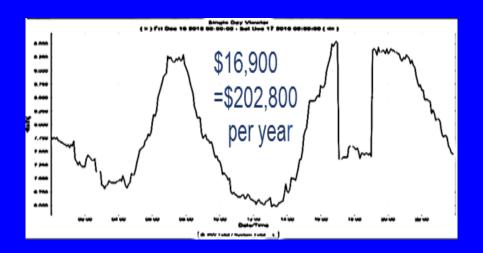
2MW/2hr storage with existing 3.4 MW PV to provide resiliency for Police HQ and Dispatch Center. Li-ion batteries provided by NEC.

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

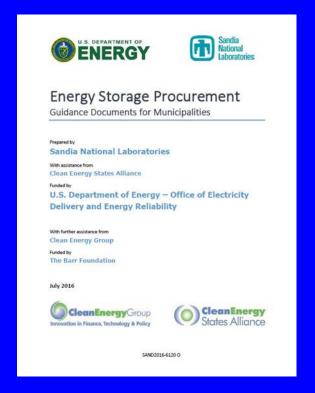
Monthly Peaks \$143,447

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.

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Prepared for:





Daniel Finn-Foley – Senior Analyst, Energy Storage



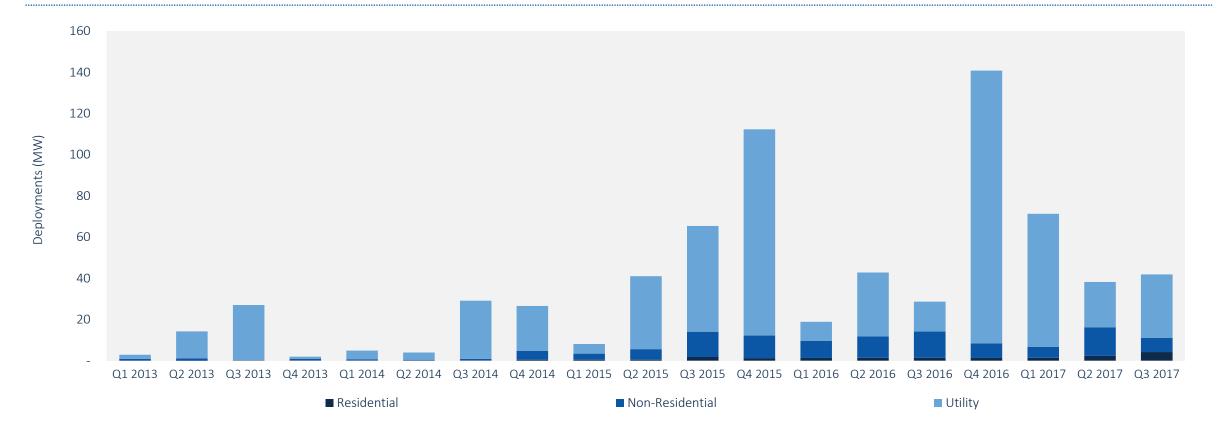
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1. Deployment Trends

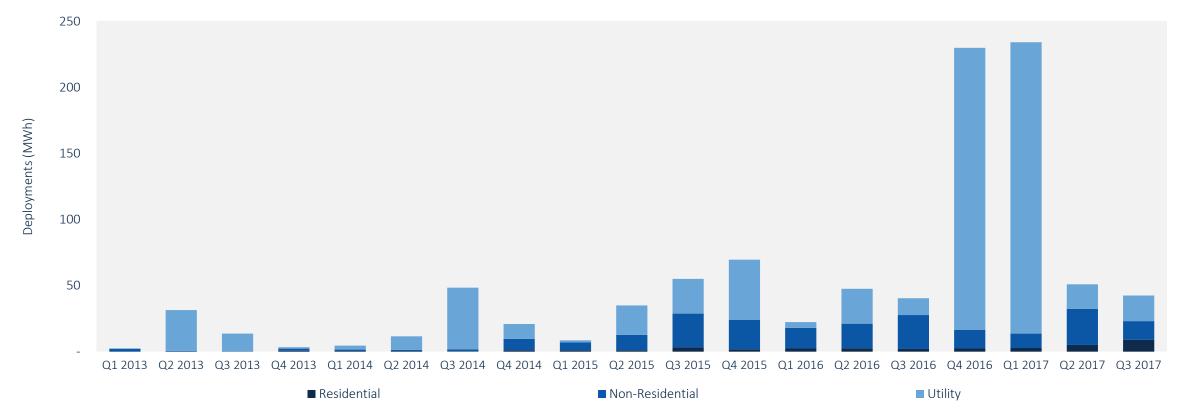
U.S. Q3 2017 Deployments in Megawatts Up 46% Over Previous Year

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



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

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



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

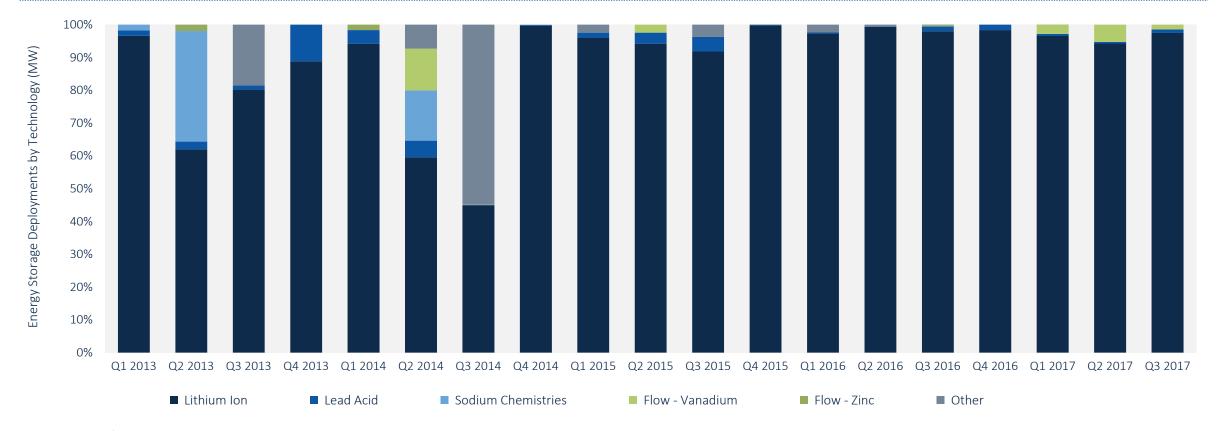
Top 3 Markets by Segment in Q3 2017 (Power Capacity)

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

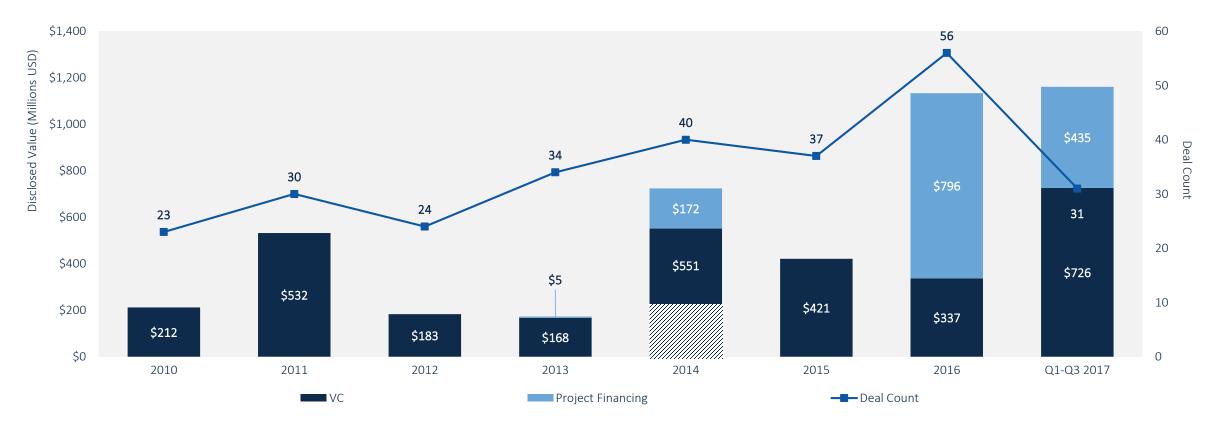
Quarterly Energy Storage Deployment Share by Technology (MW %)



^{* &}quot;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



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



2. Market Drivers

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

Nevada

Nevada PUC approved new NEM rules.

California

CPUC approved the SGIP Equity Budget to allocate program funds for projects in low-income and disadvantaged communities. The **governor** signed AB 546 into law to streamline storage permitting.

Arizona

APS proposed a new tariff program to encourage adoption of non-residential storage to address peak demand.

Massachusetts

Mass. DPU opened an investigation on whether energy storage should be allowed to net meter and whether netmetered systems can have capacity bid into ISO-NE's FCM.

Connecticut

CT DEEP opened Round 4 of its microgrid program which includes an incentive for storage.

Florida

Utility **JEA** approved a storage incentive and a new NEM compensation structure, both of which take effect in early 2018.

Hawaii

Hawaii PUC issued new program rules for net metering: Smart Export and CGS+. KIUC proposed new NEM rules that resemble those used by HECO.

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

Washington

The Utilities and Transportation Commission instructed all investor-owned utilities to consider energy storage in all future integrated resource plans.

Oregon

Portland General Electric announced plans to install \$50 million-\$100 million worth of energy storage totalling ~39 MW, the high limit of the Oregon energy storage mandate.

California

The **state legislature** passed SB 338, requiring load-serving entities to consider energy storage in integrated resource plans. **CAISO**'s ESDER Phase 3 proposes creating a load-shifting product.

New Mexico

The Public Service Company of New Mexico put out an RFP in October seeking alternatives to the soon-to-be-closed coalfired units at the San Juan generating station, specifically encouraging renewable and energy storage projects to bid.

ISO / RTO Markets

Activity continues in proceedings in PJM and MISO, while energy storage was dealt a setback in **ERCOT** as stakeholders rejected a proposal to create a frequency response product.

Federal

Four bills were introduced in the **U.S. Senate** in the fall of 2017 that could advance energy storage, including another attempt to secure a tax credit for energy storage and multiple efforts to increase resiliency after the intense 2017 hurricane season.

New York

NYISO released the final draft of its Distributed Energy Resource Pilot Program Guide.

Florida

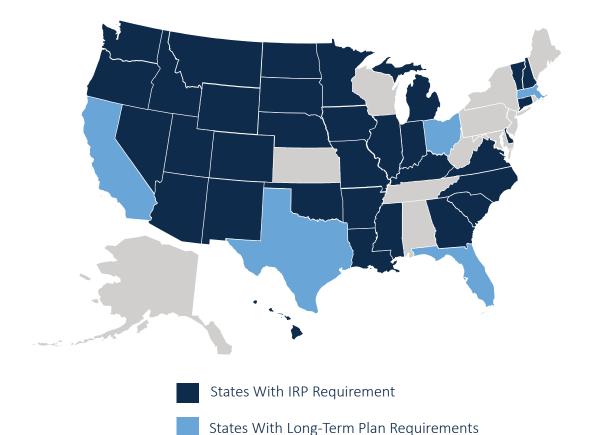
Duke's revised settlement includes plans to install up to 50 MW of energy storage in Florida as part of a pilot program alongside additional EV infrastructure.

Hawaii

HECO released its updated grid modernization plan, which highlighted energy storage throughout, including significant discussion of customer-sited storage.

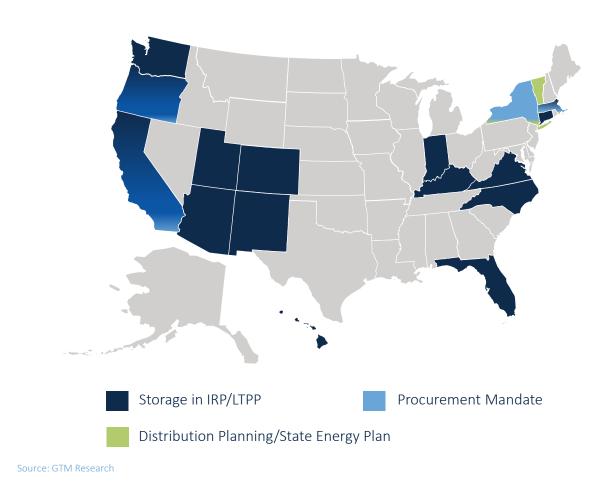
Storage Is Emerging as a Tool in IRPs Across Multiple Utilities

States With Integrated Resource Planning or Similar Requirements

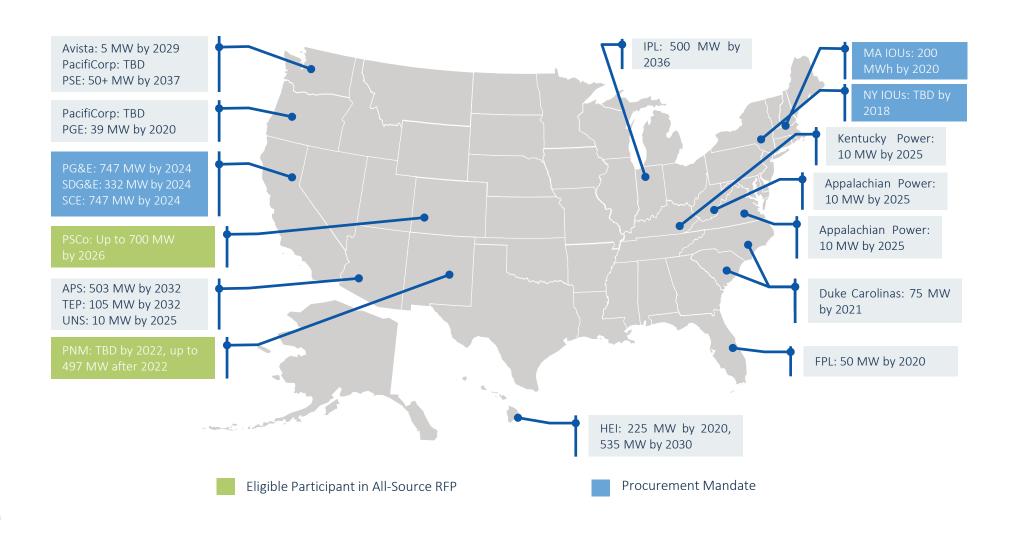


Source: EPA Energy and Environment Guide to Action – 2015, GTM Research

States With Utilities Including Storage in Resource Planning or Rate Cases



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



2017 Experienced Significant Energy Storage M&A Activity











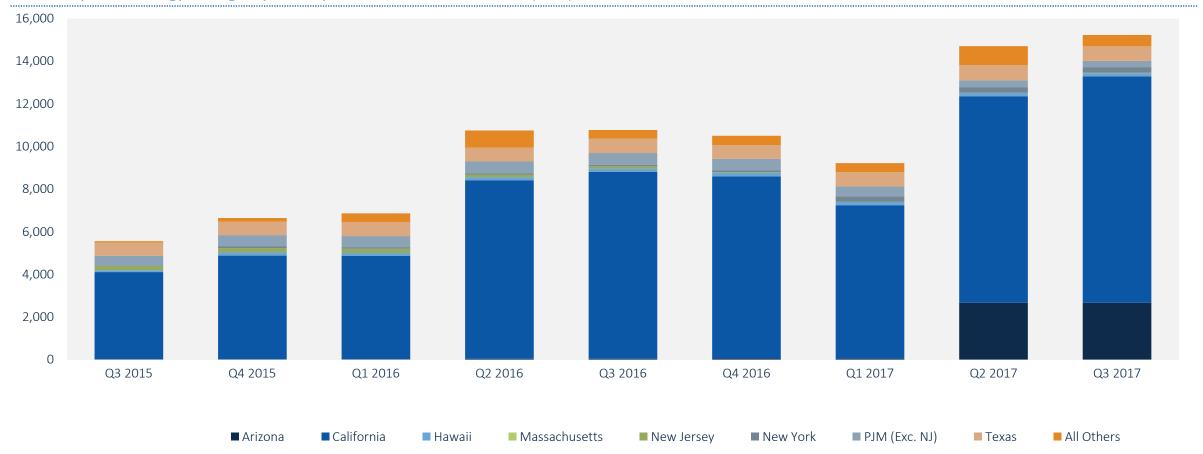




3. Outlook

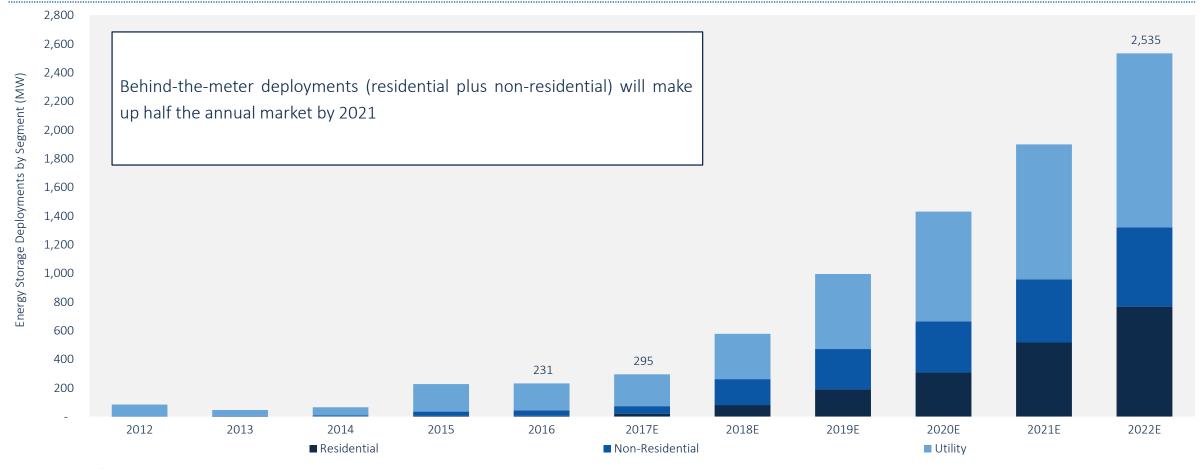
California Pipeline Grows; Other ISOs See Their Interconnection Queues Shrink

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



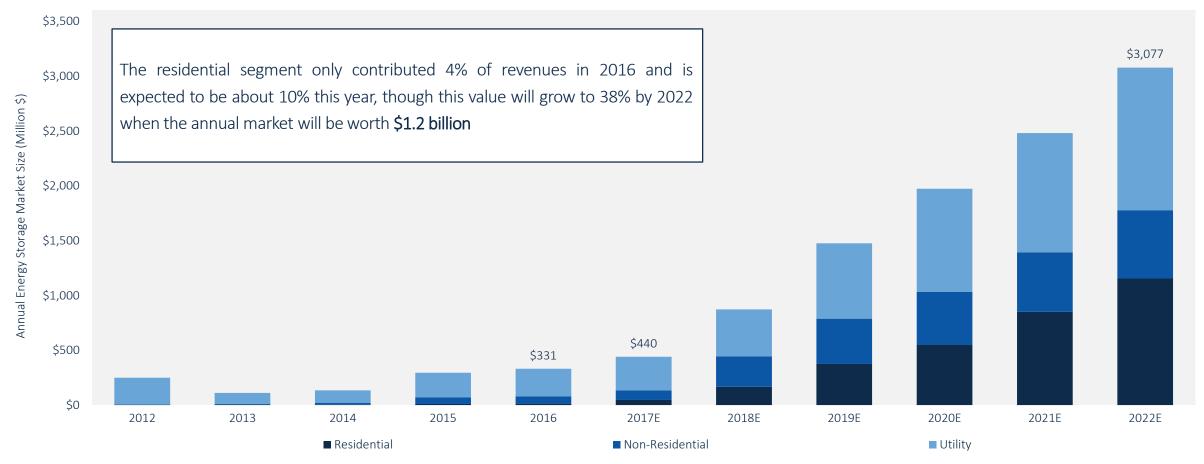
U.S. Energy Storage Annual Deployments Will Reach 2.5 GW by 2022

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



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

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



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Thank you!

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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