Key energy storage industry trends

Signposts for an accelerating market

Wood Mackenzie Power & Renewables | October 2019

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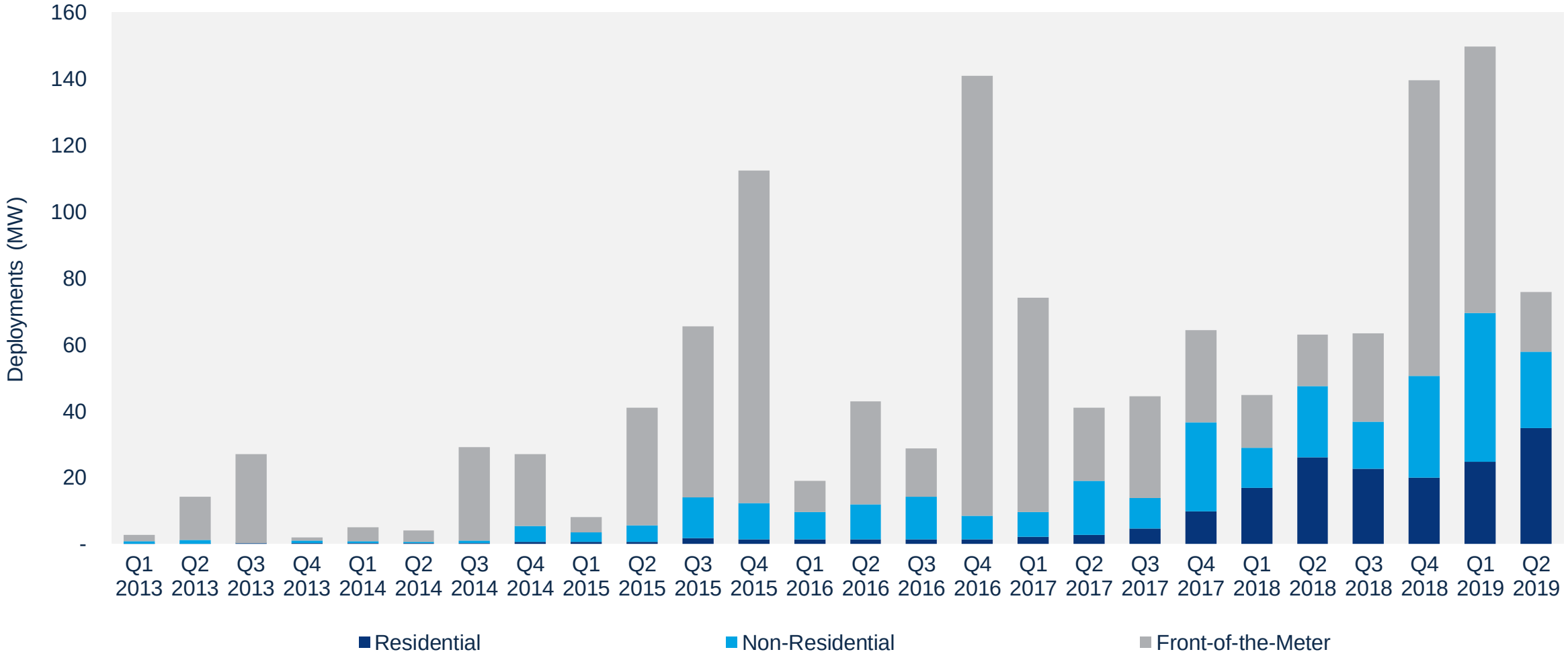
U.S. Q2 2019 deployments up 20% year-over-year

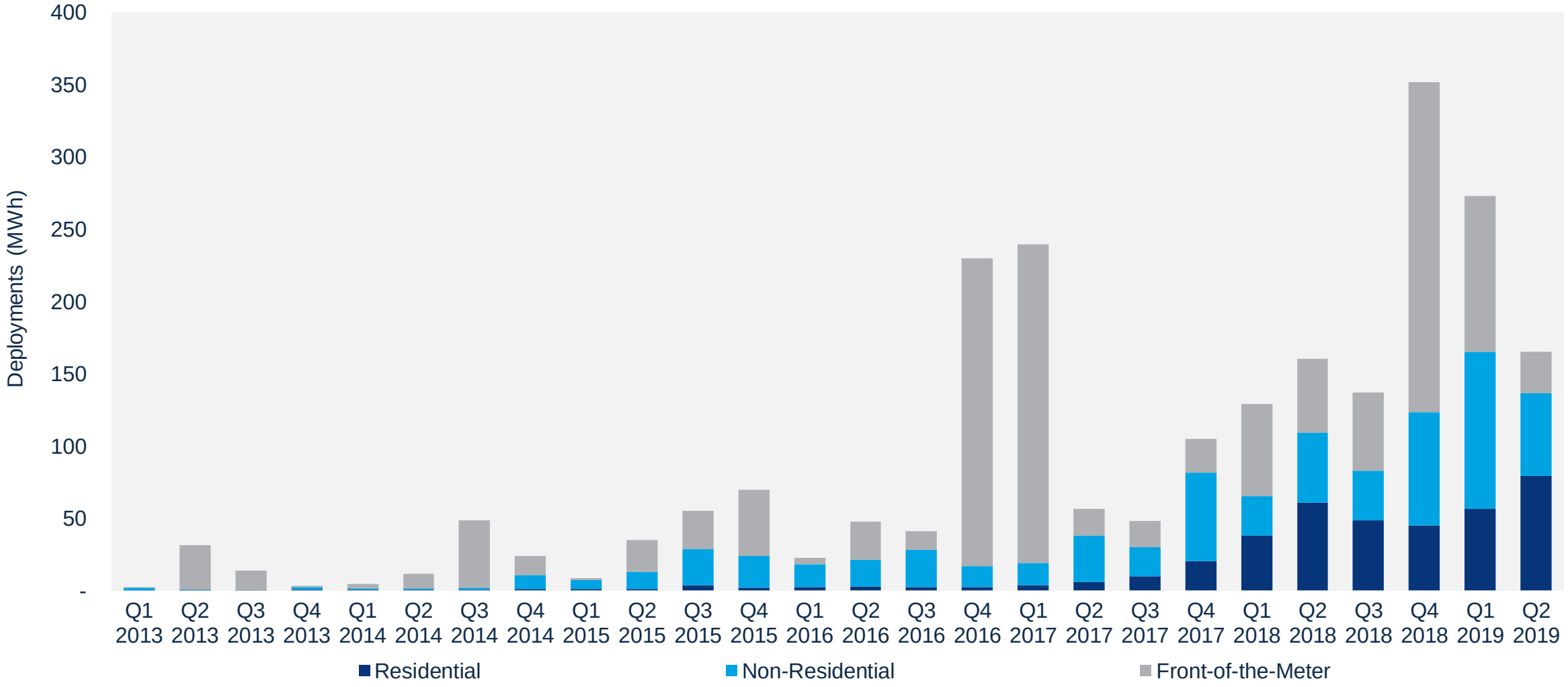
Market dropped 49% quarter-over-quarter as front-of-the-meter market quiets



Source: Wood Mackenzie Power & Renewables

U.S. Q2 2019 megawatt-hours deployed dropped 40% from Q1 2019

Market up 3% YOY with a total of 165 MWh installed



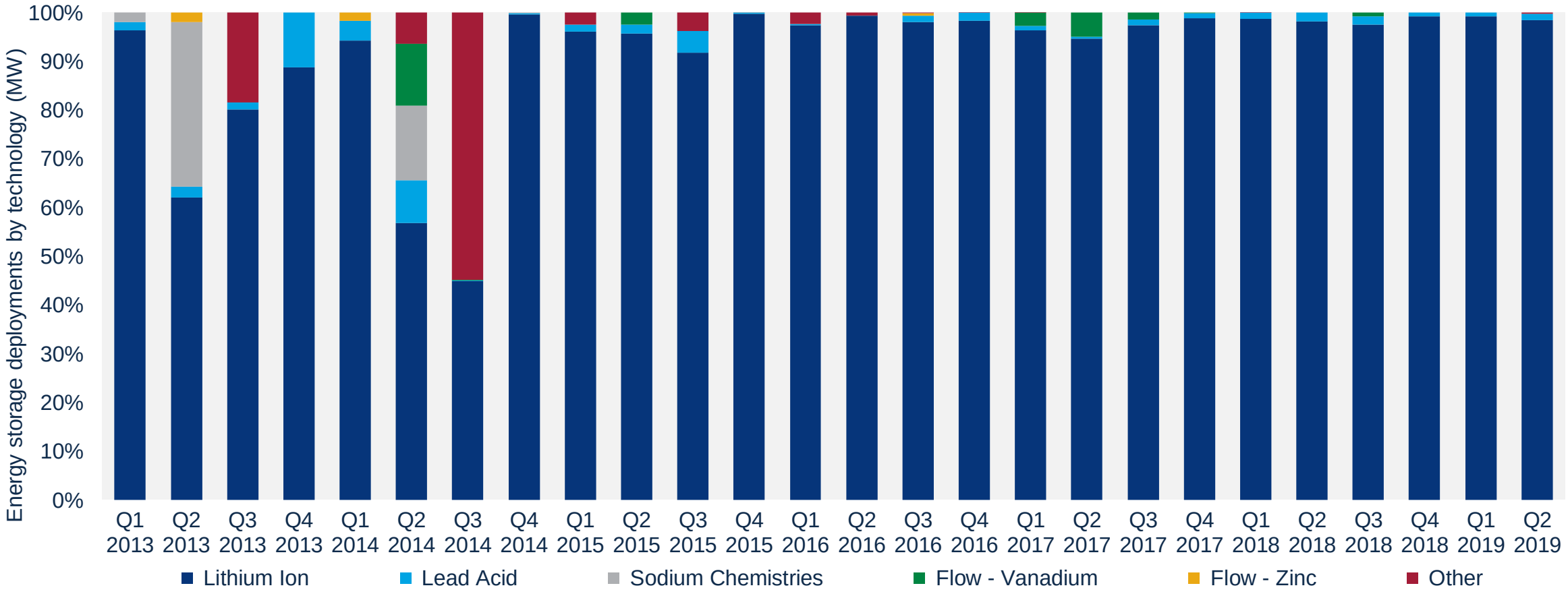
Source: Wood Mackenzie Power & Renewables

2. Technology and system price trends

Lithium-ion still dominates the market, accounting for 98.5% share of MW in Q2 2019

Lead-acid held 1.3% market share in Q2 2019, while an iron flow battery project accounted for the final 0.2%

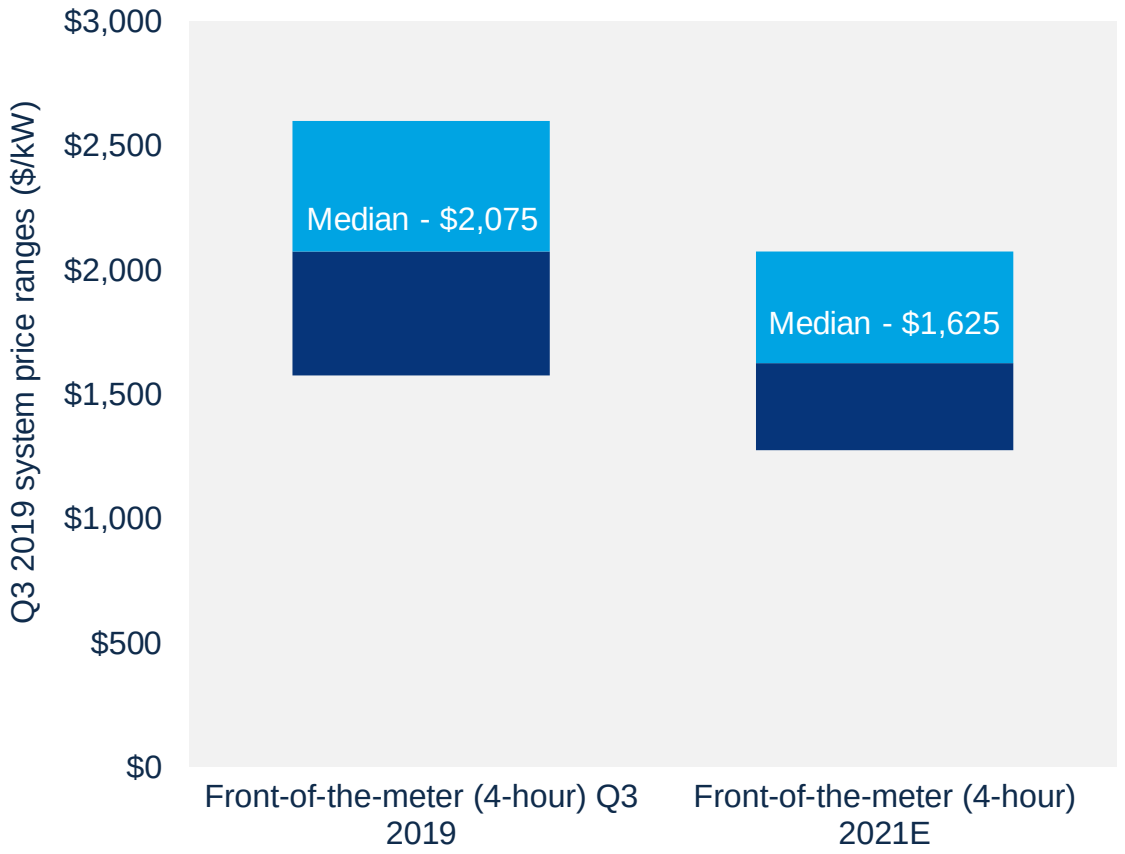
Quarterly energy storage deployment share by technology (MW %)



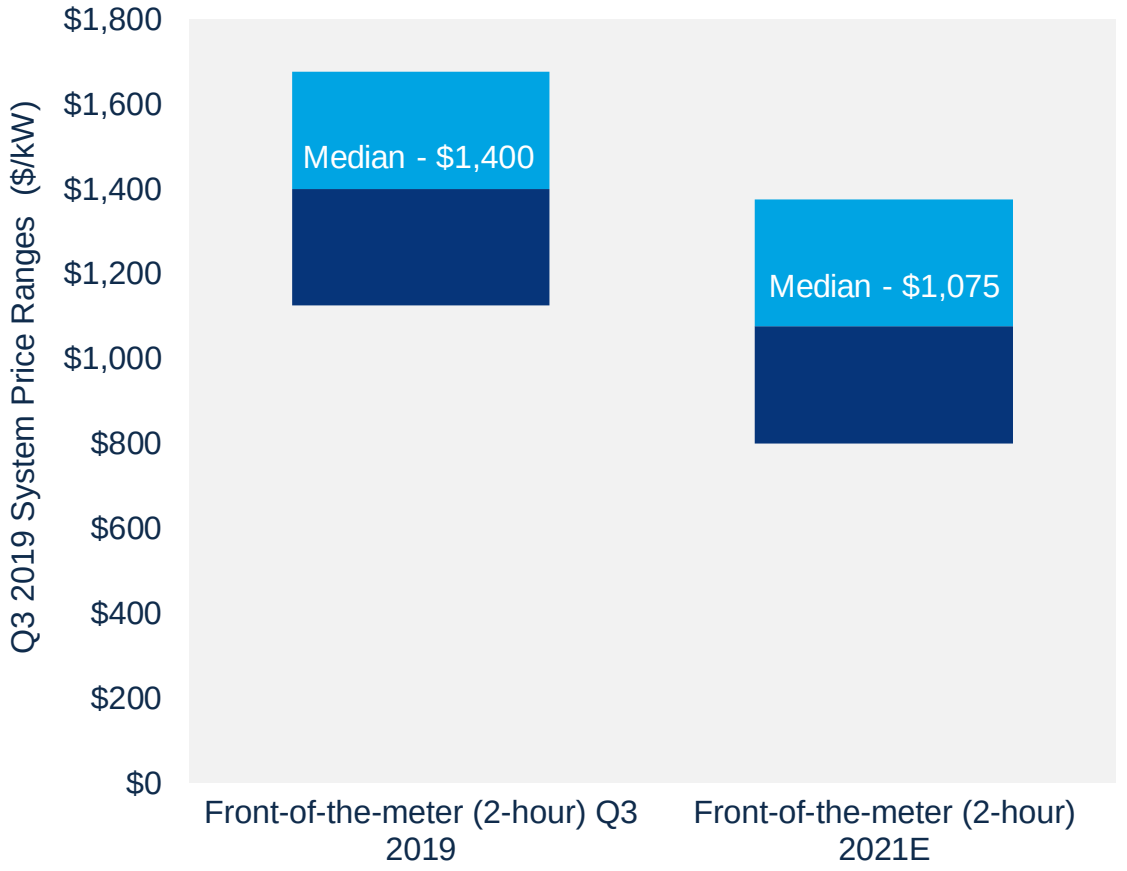
* “Other” includes flywheel and unidentified energy storage technologies.
Source: Wood Mackenzie Power & Renewables

Long- and medium-duration FTM system prices set to decline by more than 15% by 2021

Front-of-the-meter fully installed system price trends, Q3 2019 and 2021E, 4-hour ($/kW)



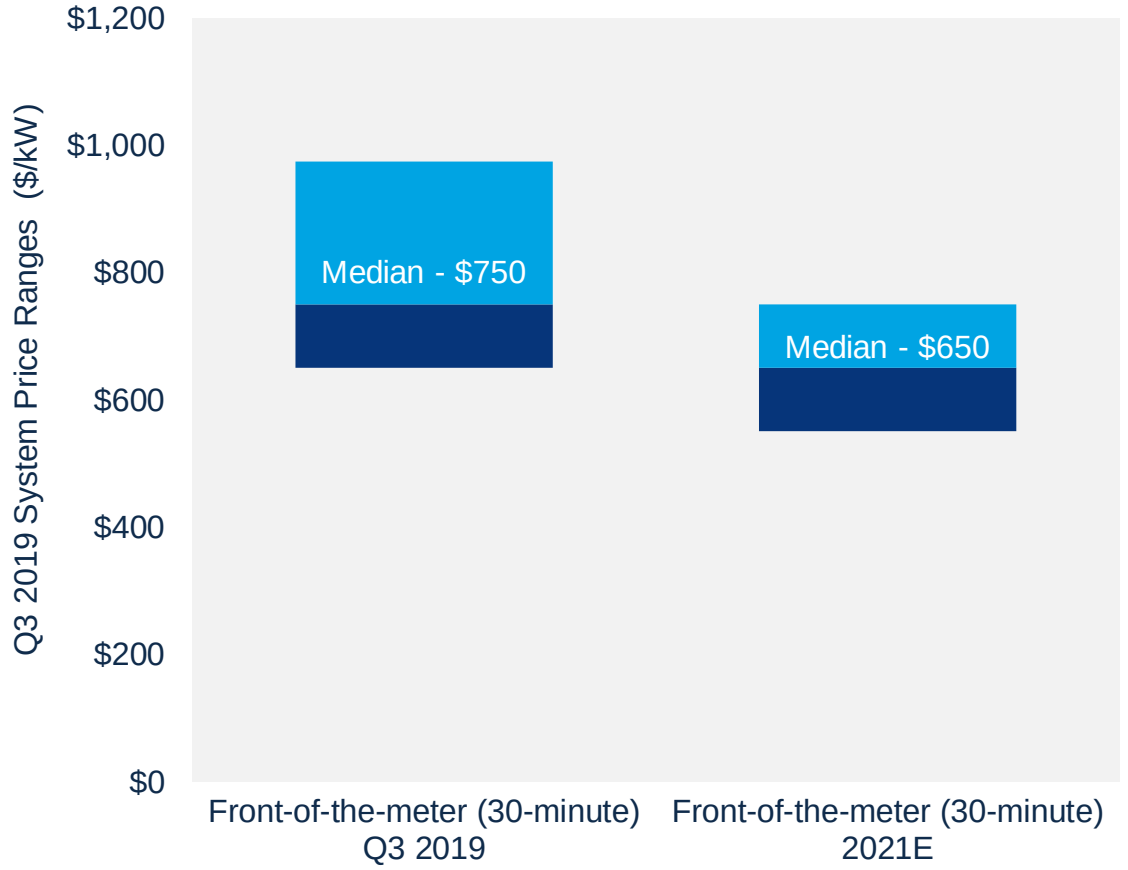
Front-of-the-meter fully installed system price trends, Q3 2019 and 2021E, 2-hour ($/kW)



Source: Wood Mackenzie Power & Renewables

Short-duration FTM system prices expected to decline by 10% over the next two years

Front-of-the-meter fully installed system price trends, Q3 2019 and 2021E, 30-min. ($/kW)



Source: Wood Mackenzie Power & Renewables

3. Market drivers and outlook

Front-of-the-meter policy and market developments, Q2 2019

Oregon

PGE's integrated resource plan (IRP) includes some storage, but not significant amounts compared to other RFP and IRP announcements over the past two quarters.

California

L.A. Dept. of Water and Power announced a 300 MW/1,200 MWh solar-paired storage project. **Glendale Power & Light** released an RFP to replace a proposed natural-gas peaker.

New Mexico

PNM's IRP includes significant storage announcements.

Texas

Distribution utilities in Texas can now own energy storage thanks to a bill signed by **Gov. Greg Abbott** this summer, effective 3 September.

Hawaii

HECO released Phase 2 of its renewable procurement, including GWh-scale storage procurements.

Nevada

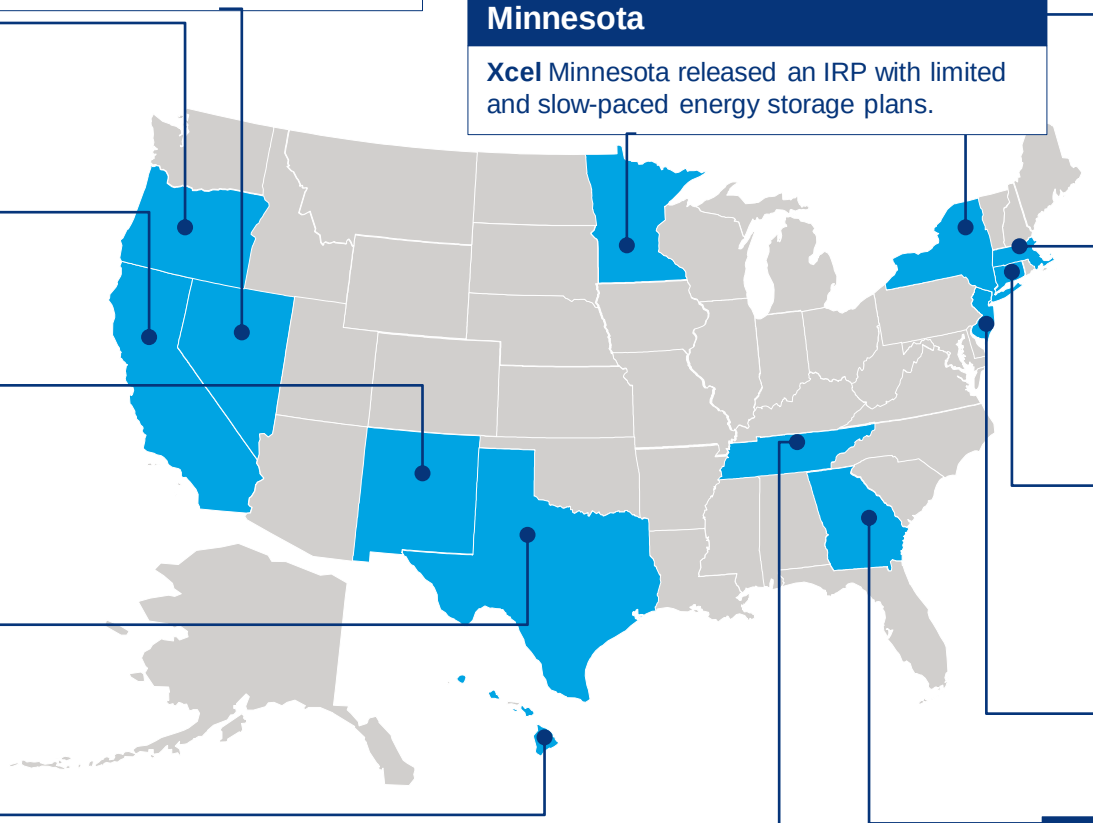
Nevada Energy awarded 509 MW of energy storage for its latest solar-plus-storage procurement.

Multiple

PacifiCorp's latest IRP includes upside for storage of as much as 2.7 to 3.7 GW.

Minnesota

Xcel Minnesota released an IRP with limited and slow-paced energy storage plans.



New York

FDNY issued new proposed rules for outdoor storage permitting. The results of the **peaker plant replacement** study were released. **NYISO** and stakeholders continue to go back and forth on participation barriers. Utilities released bulk storage plans, and **Con Ed** released a distribution deferral RFP.

Massachusetts

The **Dept. of Public Utilities** opened an investigation into DG interconnection, including storage. The **Dept. of Energy Resources** issued updated draft language for the Clean Peak Standard, with favorable provisions for storage.

Connecticut

Connecticut Public Utilities Regulatory Authority opened a docket on the value of distributed energy resources.

New Jersey

Rutgers University published a study of the investment needed to meet NJ's storage goals. The **Board of Public Utilities** included provisions for the state's storage mandate as part of the 2019 Energy Master Plan.

Georgia

Georgia PSC approved Georgia Power's plan to own and operate 80 MW of energy storage, along with new renewable build-out.

Federal

The U.S. Senate's BEST act would direct the DOE to fund long-duration storage research and demonstration projects.

Tennessee

Tennessee Valley Authority's IRP could drive 5,300 MW of energy storage through 2038.

Source: Wood Mackenzie Power & Renewables

Behind-the-meter policy and market developments, Q2 2019

New York

NYSERDA announced $15 million in BTM storage incentives available immediately on Long Island ($55 million in total committed). The NYC fire department, **FDNY,** issued new proposed rules for outdoor storage permitting. The **Public Service Commission** issued an order that storage is required to pay contract demand charges under standby and buyback rates; it also issued a progress update on the pilot of a DER data platform.

New Hampshire

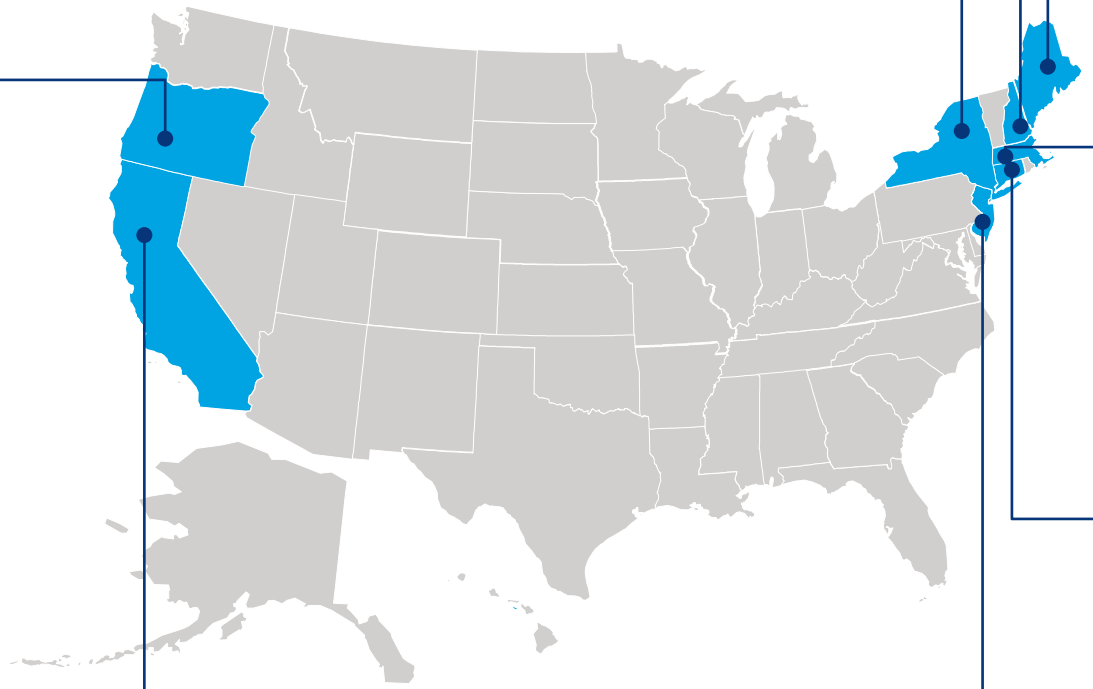
Eversource issued a proposal for a program to increase reliability, reduce peak demand and reduce GHG emissions using a combination of battery storage, DER and energy efficiency.

Maine

Governor Janet Mills signed a bill to establish a commission to study impacts of storage in Maine, with a report due by December 2019.

Oregon

Oregon State Legislature passed and the **governor** signed a bill establishing an incentive program focusing on low and moderate income solar-plus-storage projects.



Massachusetts

Dept. of Public Utilities began studying DG interconnection, including storage. **National Grid** allowed residential battery systems enrolling in its Connected Solutions program to claim 100% of the annual incentive if enrolled before 1 August.

Connecticut

Connecticut Public Utilities Regulatory Authority opened a docket on the value of distributed energy resources.

California

The **California Public Utilities Commission** adopted rules for a new greenhouse gas signal and energy equity and resilience funding for marginalized and high-risk communities under the Self-Generation Incentive Program and proposed changes to the Demand Response Auction Mechanism, including an extension through 2022.

New Jersey

Rutgers University published a study analyzing investment needed for the state to meet its storage goals. The **Board of Public Utilities** included provisions for the state's storage mandate as part of the 2019 Energy Master Plan.

Federal/national

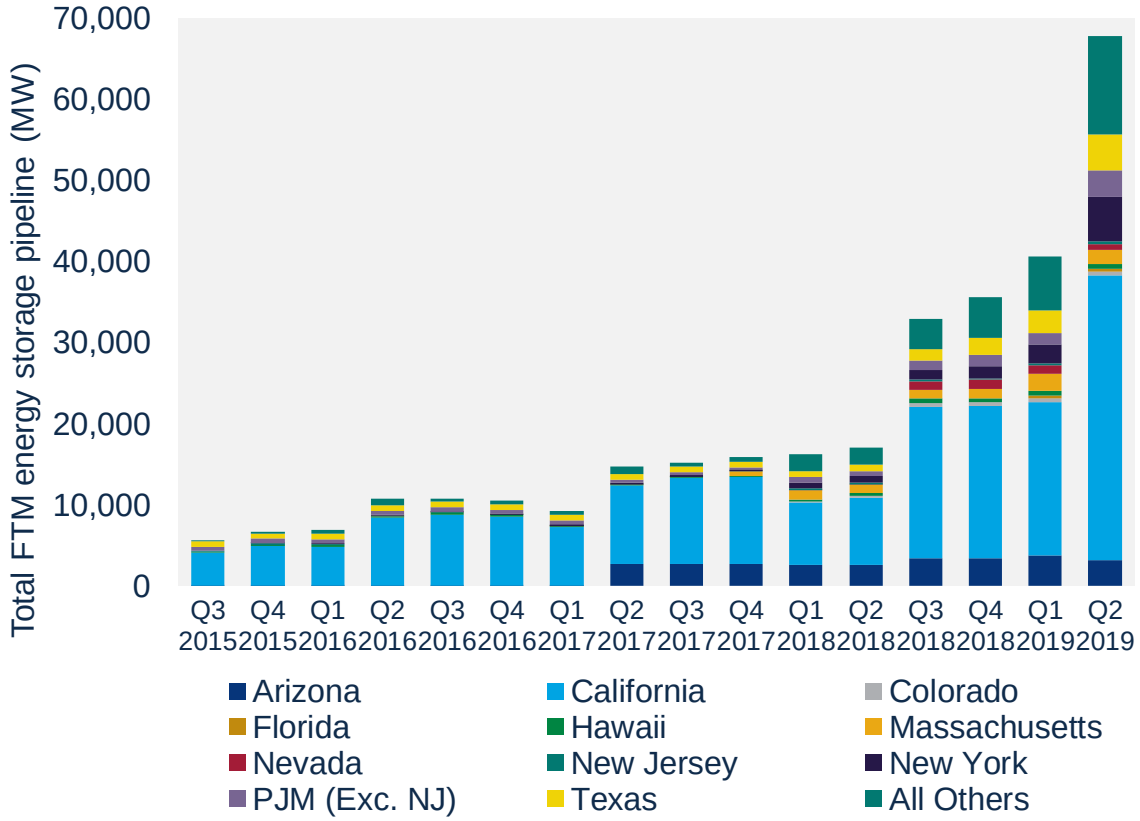
DOE announced funding for multiple tribal energy projects, several of which have a storage component.

Source: Wood Mackenzie Power & Renewables

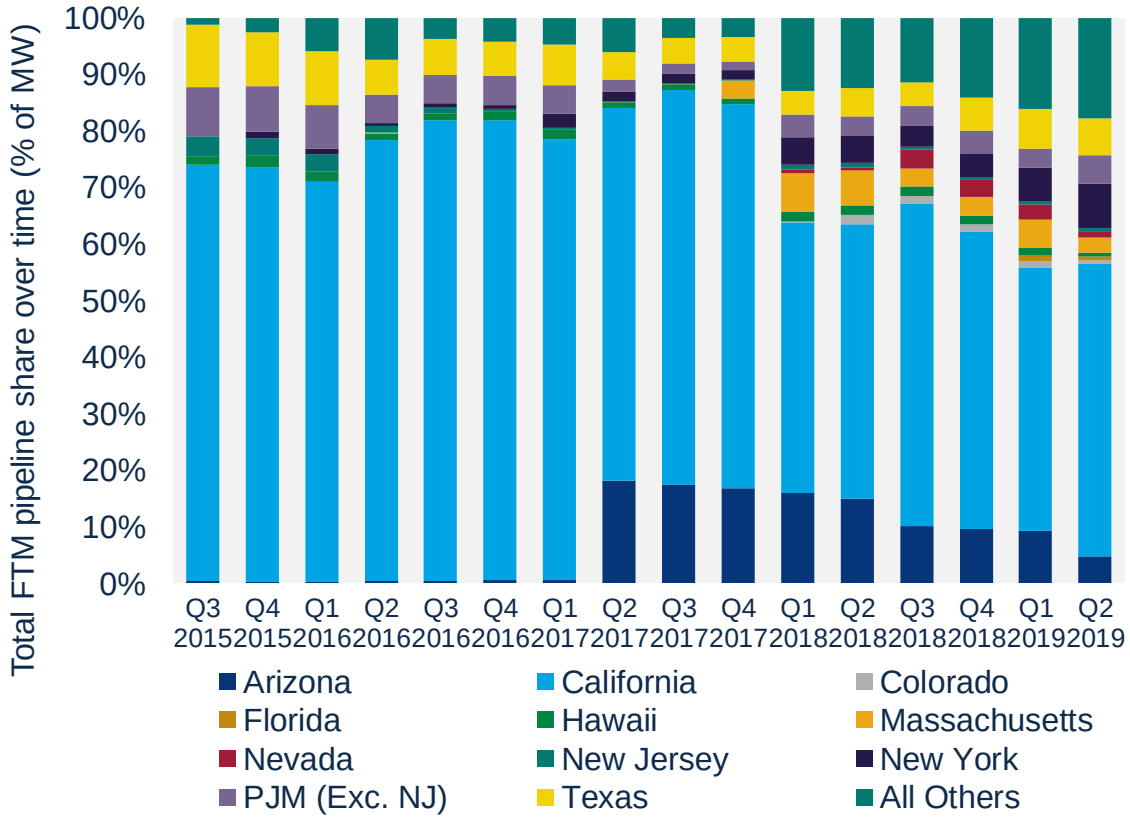
Total FTM pipeline swells to over 67 GW following latest ISO cluster applications

This represents a 67% increase to the pipeline, following a pattern of rapid growth in Q2 and Q3 each year

U.S. front-of-the-meter energy storage pipeline by market, Q3 2015-Q2 2019 (MW)



U.S. front-of-the-meter energy storage pipeline market share, Q3 2015-Q2 2019 (%)



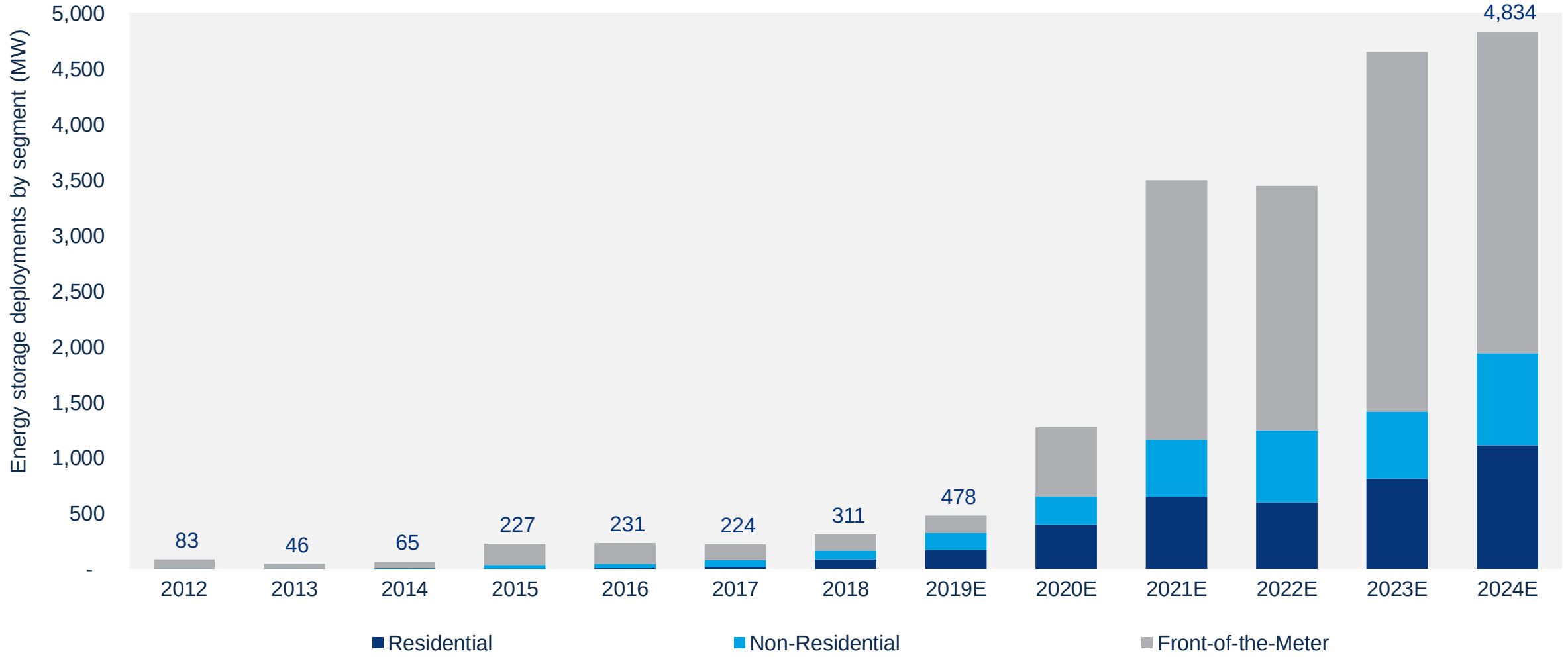
- Most interconnection queues grew massively this quarter, which combined with several large-scale utility announcements increased the pipeline to record levels. While California did retake its position as the holder of more than 50% of the market, it only barely reached this benchmark, showing that other markets continue to see interest.

Source: Wood Mackenzie Power & Renewables

U.S. energy storage annual deployments will reach over 4.8 GW by 2024

Utility procurements, changing tariffs and grid service opportunities all drive the market forward

U.S. energy storage annual deployment forecast, 2012-2024E (MW)

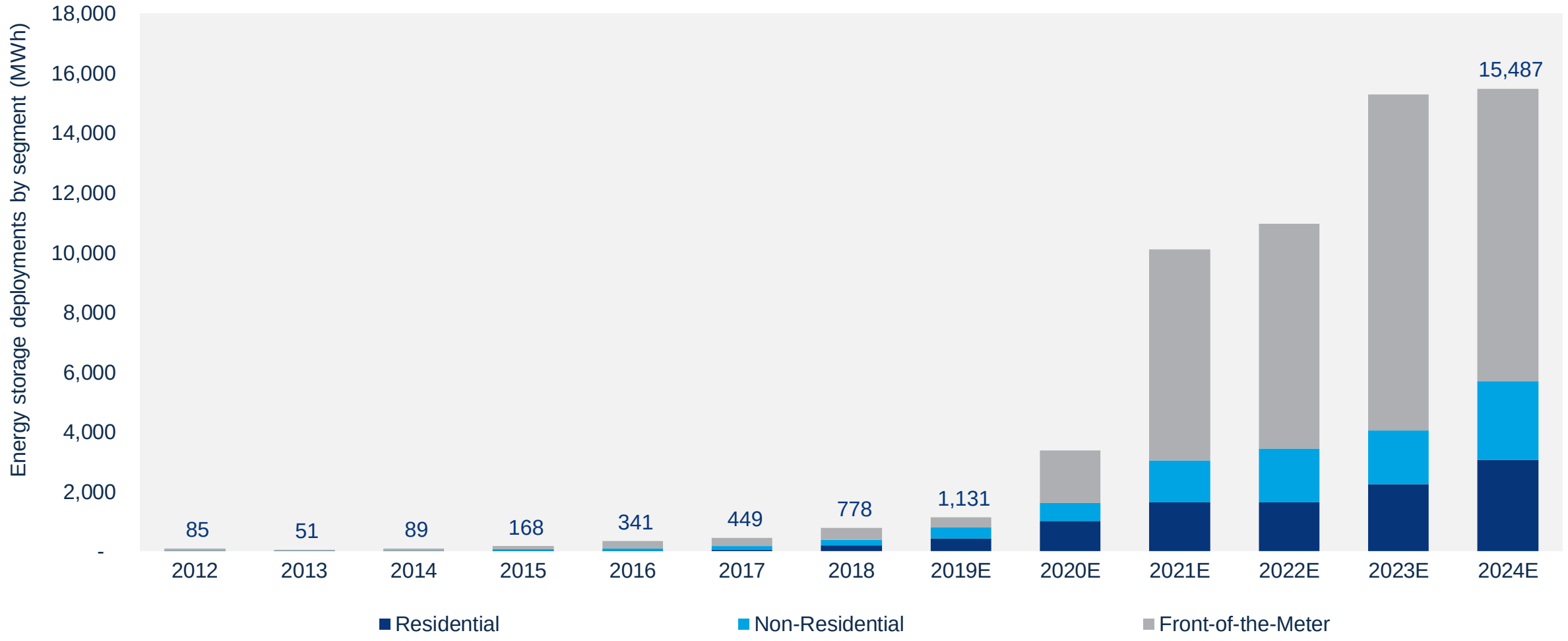


Source: Wood Mackenzie Power & Renewables

U.S. market will reach 15.5 GWh in annual deployments by 2024

4-hour systems becoming the norm for front-of-the-meter systems; average BTM durations inch toward 3 hours

U.S. energy storage annual deployment forecast, 2012-2024E (MWh)

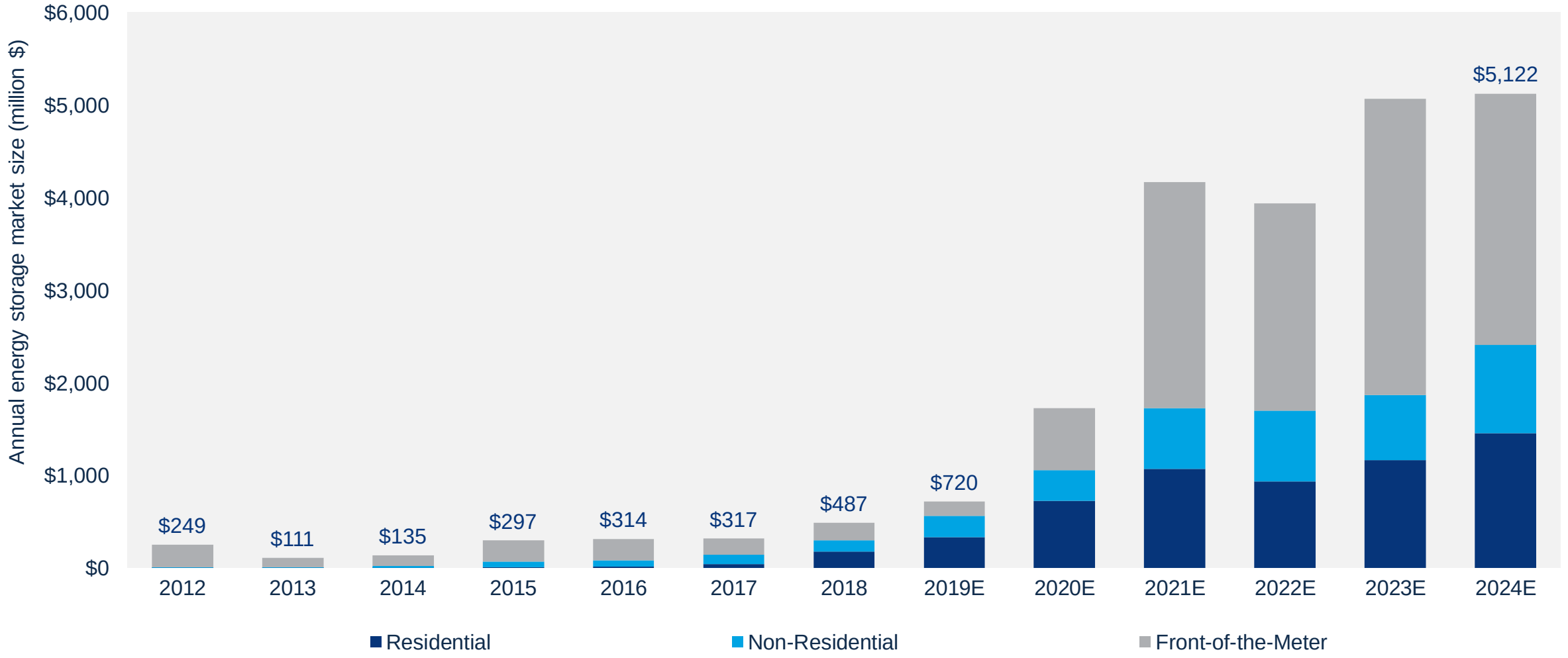


Source: Wood Mackenzie Power & Renewables

U.S. energy storage will be a $5.1 billion market in 2024

Annual value to more double between 2019 and 2020

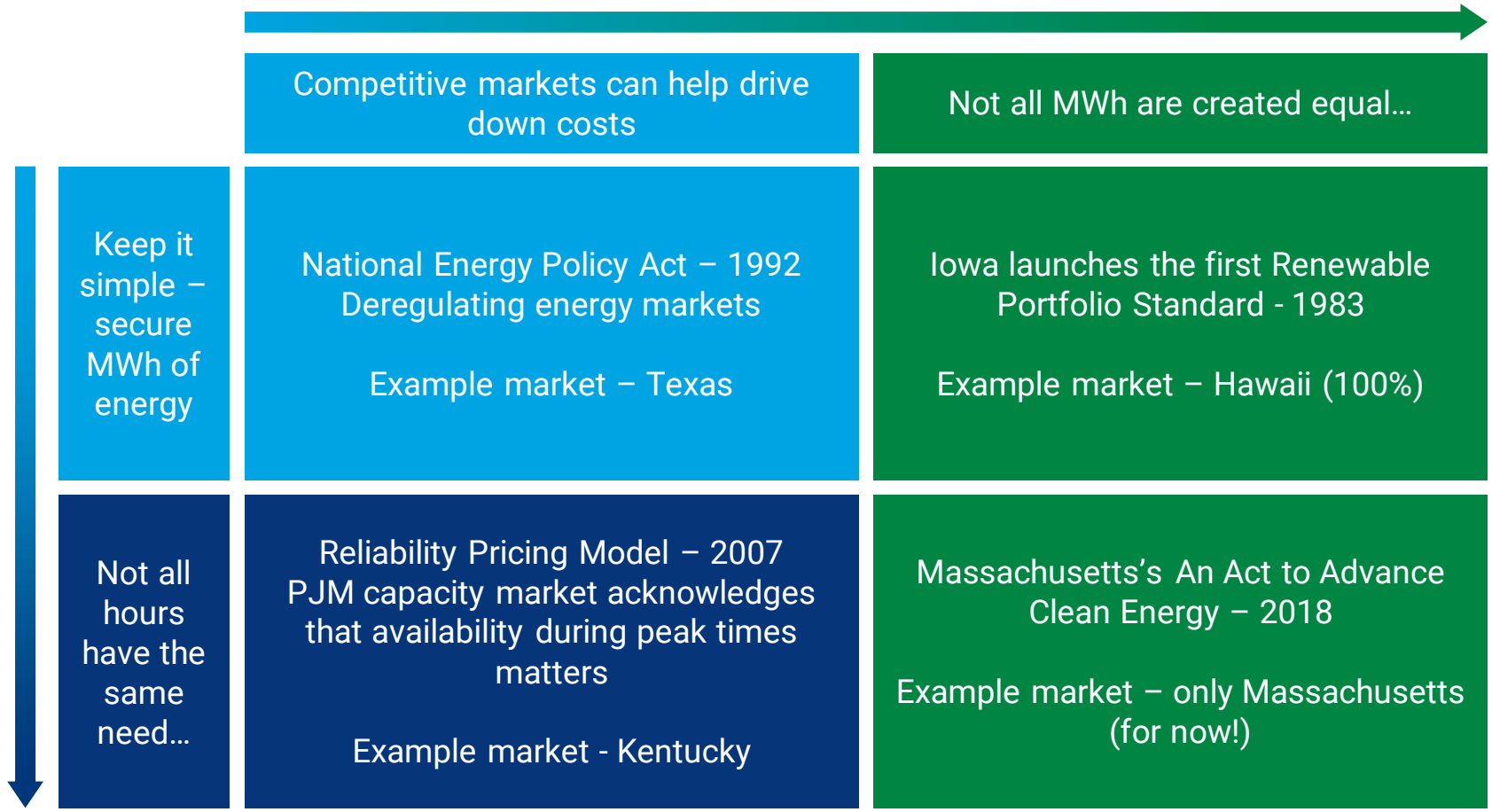
U.S. annual energy storage market size, 2012-2024E (million $)



Source: Wood Mackenzie Power & Renewables. Note: Market size is reported as energy storage system deployment revenue (product of deployments and installed system prices).

The new foundation for hybrid energy storage systems – recognizing value

True value for hybrid storage systems lies at the intersection of green policy and system needs



- **As you move in either direction, either towards valuing renewables, or valuing delivery during peak hours, storage's value increases.**
- **As you move in *both* directions, valuing renewables during certain hours, storage's value increases exponentially.**
- **The clean peak standard, if it becomes a model as capacity markets and the RPS did, could drive massive storage growth.**

Q&A