

Energy storage 2018 recap and trends for 2019

Evolving Perspectives on Energy Storage, Kleinman Center

Ravi Manghani | March 2019





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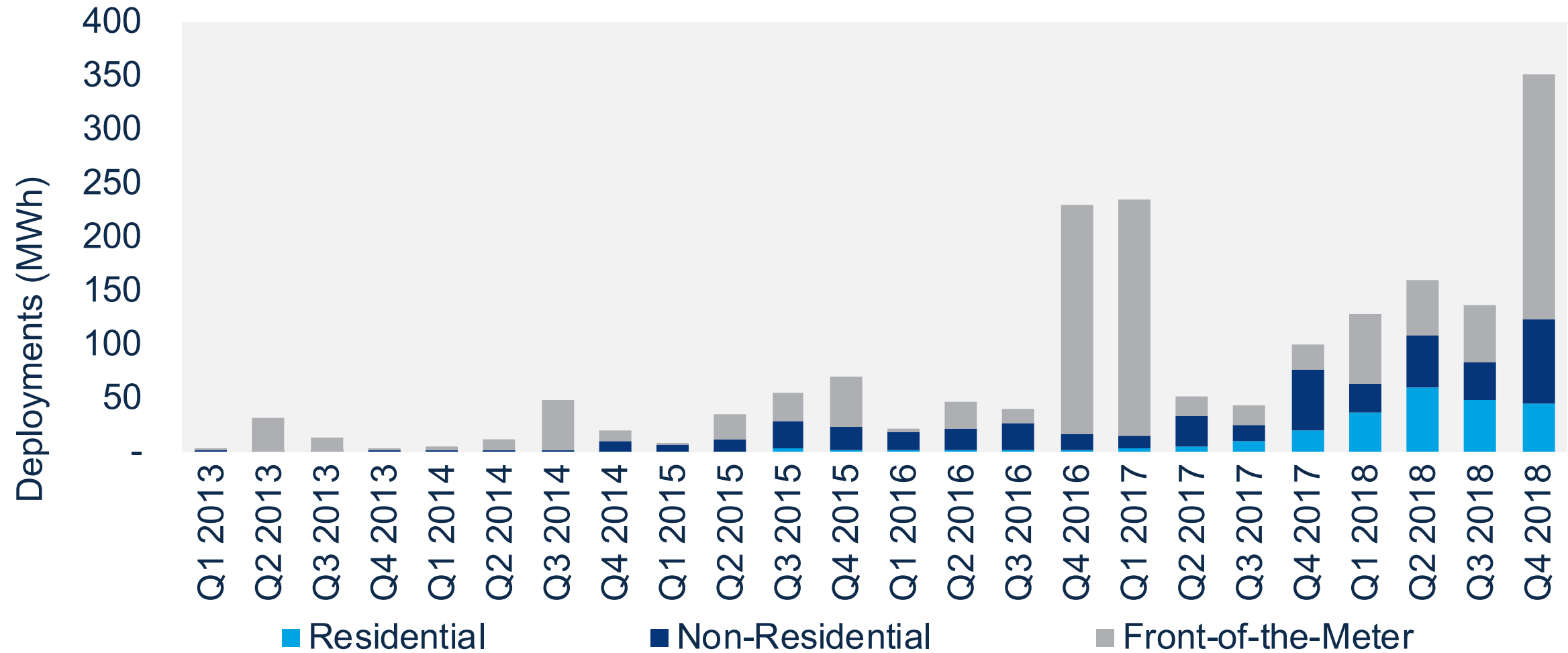
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777 MWh of storage deployed in the U.S. in 2018, growing 80% from 2017




Q4 2018 surpassed previous MWh record by 50%



Top energy storage markets 2018

California leads across all segments, Hawaii jumps into top three for FTM

Top 3 markets by segment in 2018 (power capacity)

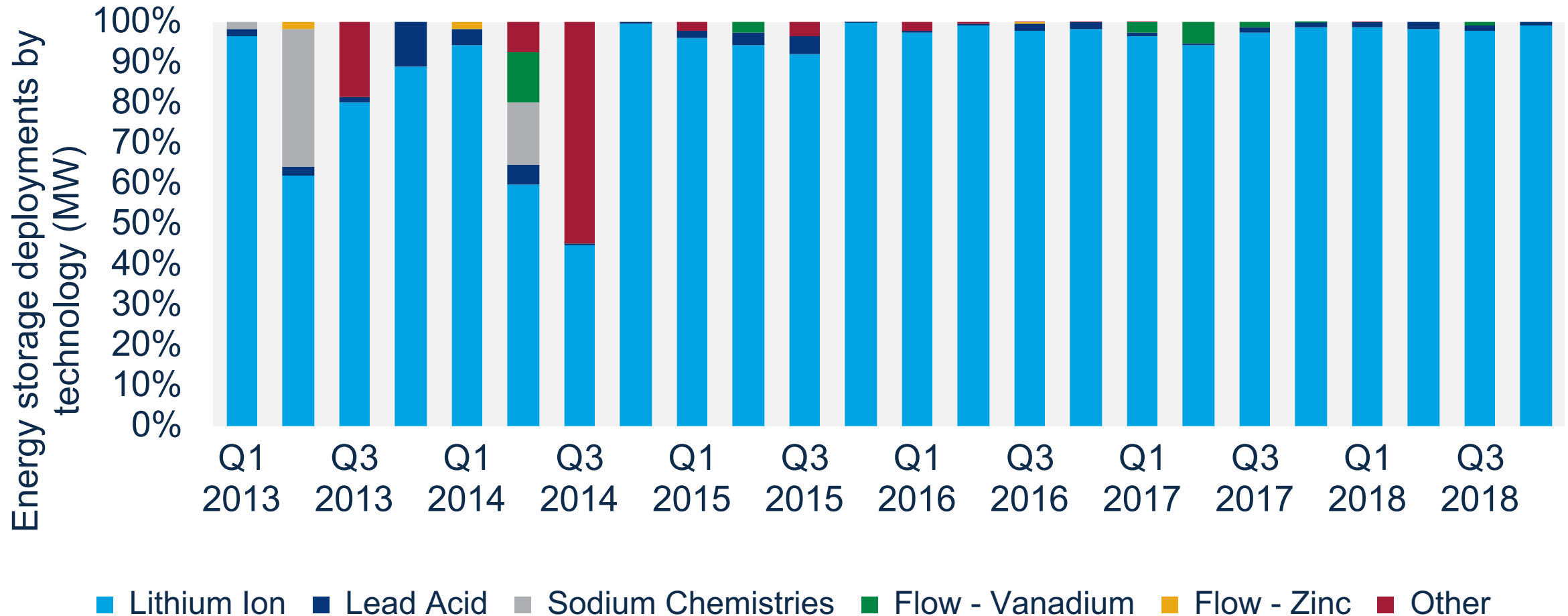
| Rank | | Residential | Non-residential | Front-of-the-meter |
|------|---|-------------|-----------------|--------------------|
| 1 |  | California | California | California |
| 2 |  | All Others | Hawaii | All Others |
| 3 |  | Hawaii | New York | Hawaii |

Source: Wood Mackenzie Power & Renewables

Lithium-ion still dominates the market, accounting for 99.2% share of MW in Q4 2018

Lead-acid held 0.8% market share; vanadium flow had a small showing in 2018 as a whole

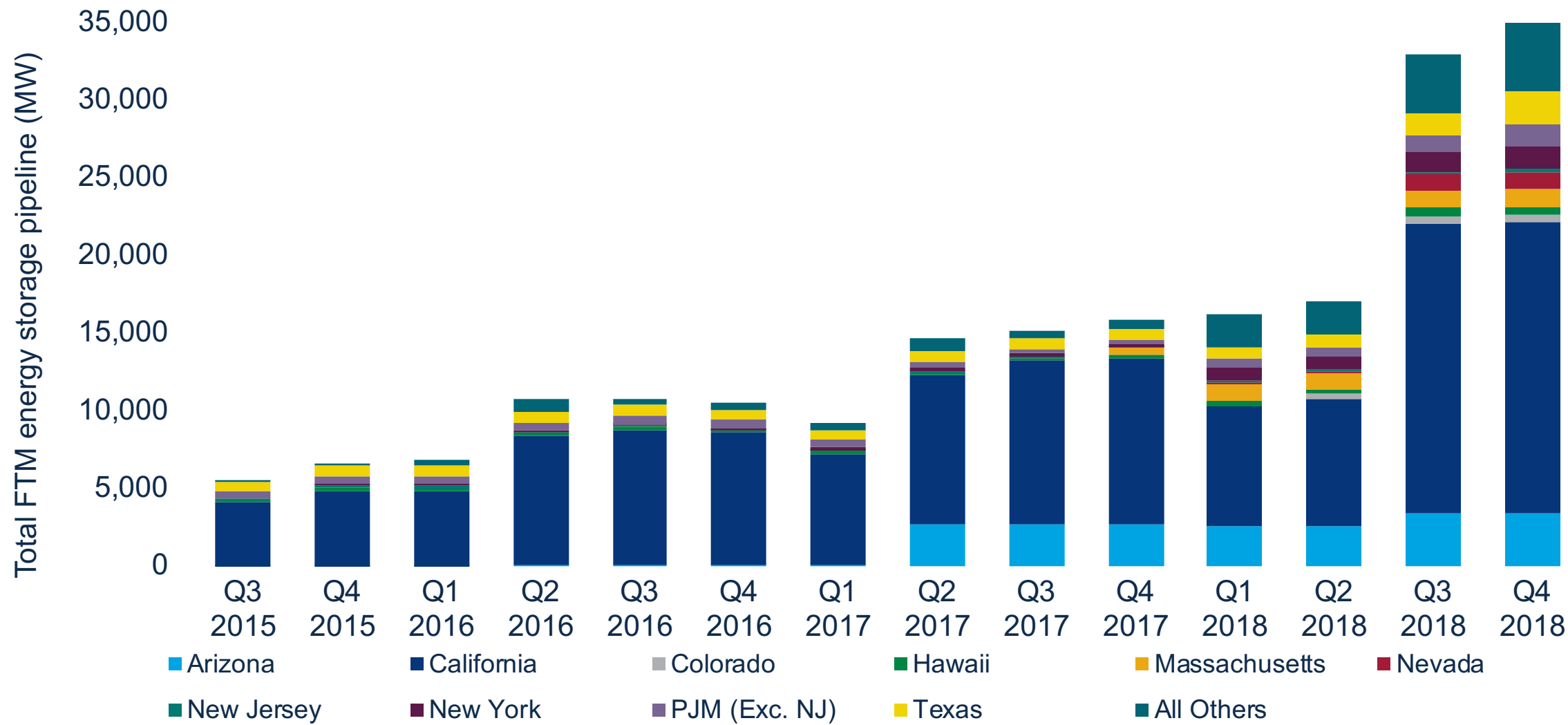
Quarterly energy storage deployment share by technology (MW %)



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

Source: Wood Mackenzie Power & Renewables

U.S. front-of-the-meter pipeline nearly doubles in the wake of Order 841



Source: Wood Mackenzie Power & Renewables/ESA U.S. energy storage monitor: 2018 Year in review and Q1 2019

Market dynamics affecting behind-the-meter storage growth

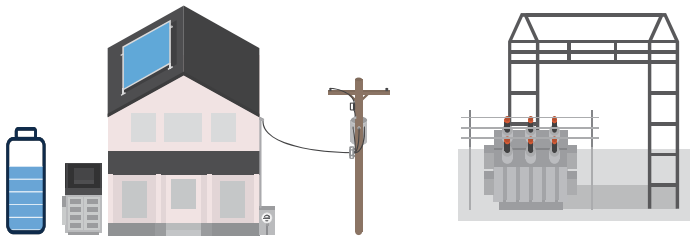
Changing Utility Rate Tariffs



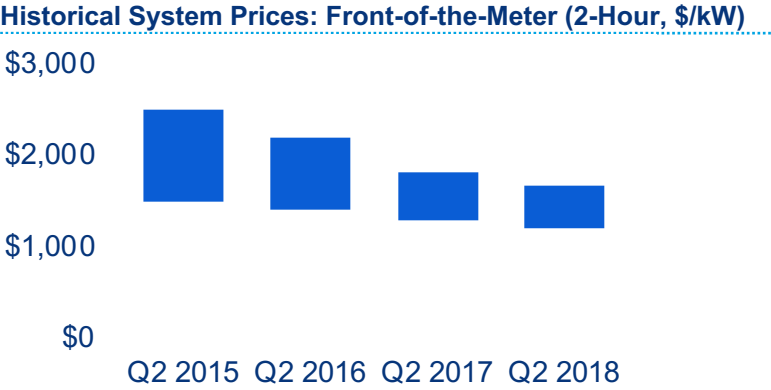
Net-Energy Metering Shifts



Grid Service Opportunities



Declining System Prices

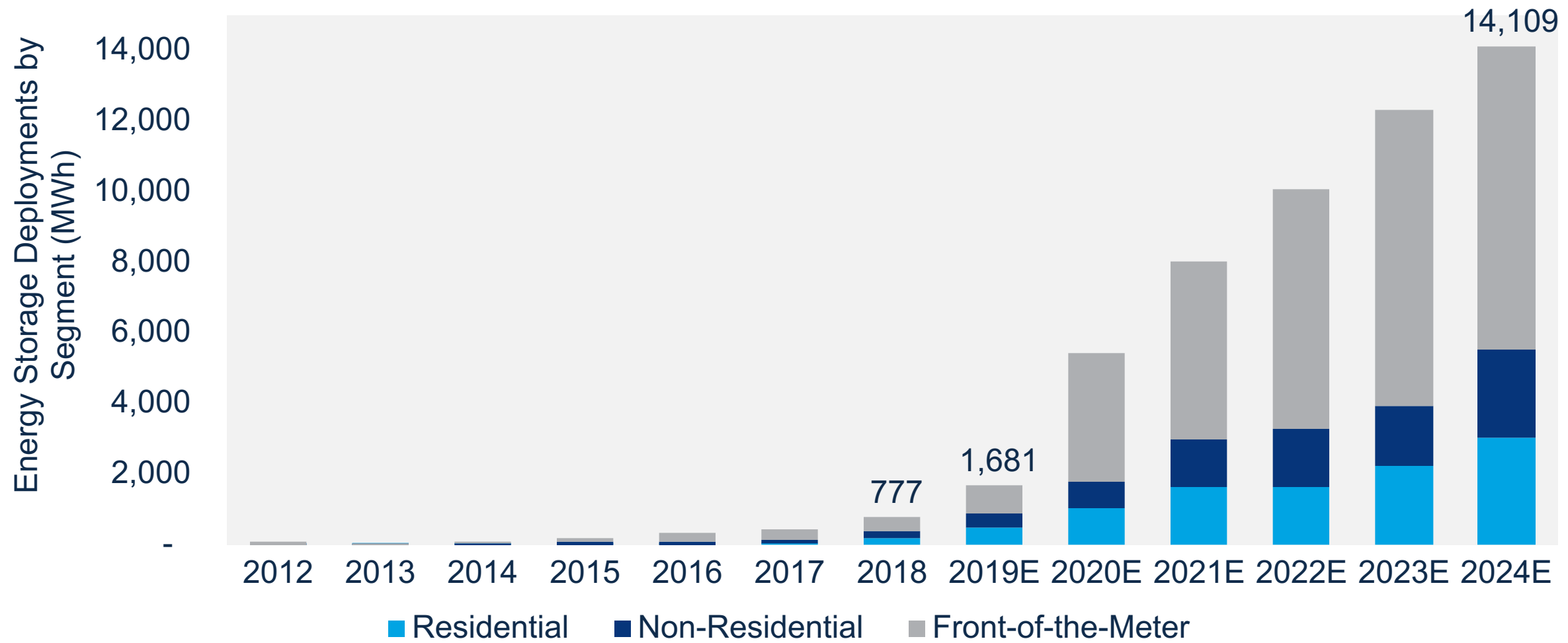


Source: Wood Mackenzie Power & Renewables

U.S. market will reach nearly 14 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)





Q&A ?