Energy Storage, Resilience, & Equity

NASEO Midwest Energy Conference

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www.energystorage.org

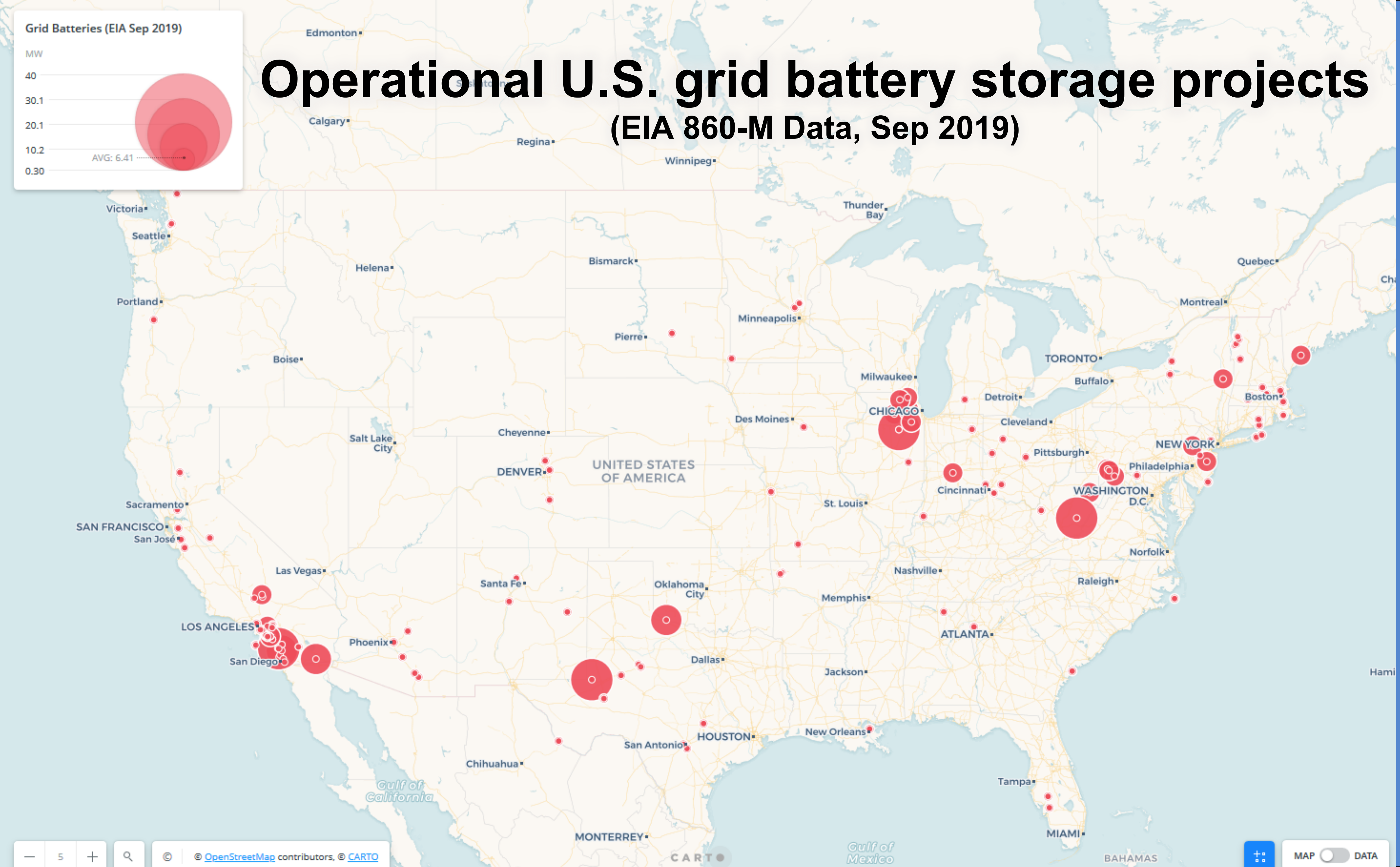
Value propositions for the power system

Optimize the electric grid & enable system transformation

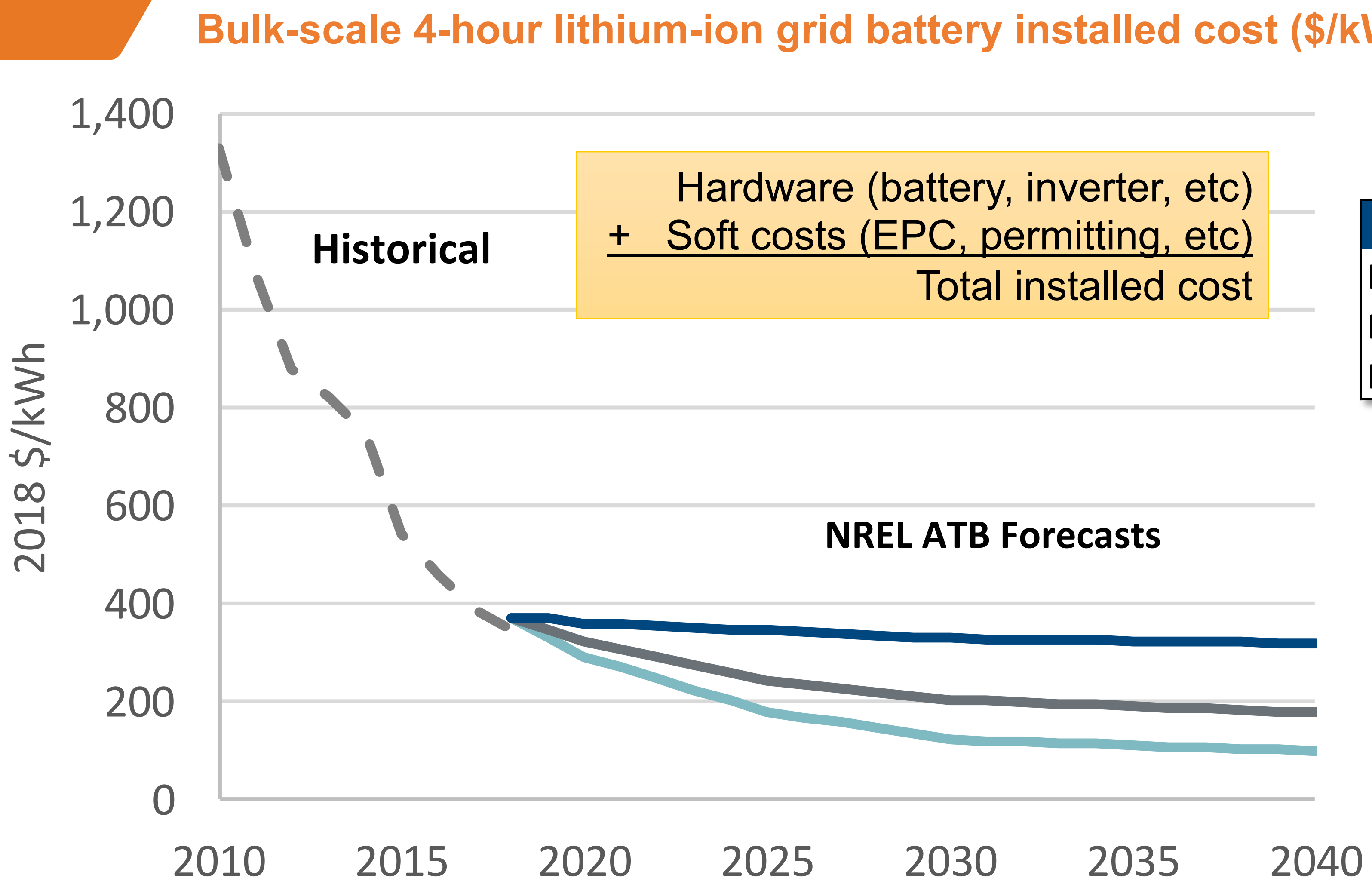
1. **Efficiency** // save households & businesses money
2. **Resilience** // make service more disruption-proof
3. **Adaptability** // integrate diverse, changing resource mix

Operational U.S. grid battery storage projects

(EIA 860-M Data, Sep 2019)



Battery storage installed costs



Annual Cost Decline Rates from 2018

	2025	2030	2040
Low Cost	-10%	-9%	-6%
Mid Cost	-6%	-5%	-3%
High Cost	-1%	-1%	-1%

Source: Bloomberg New Energy Finance (2018) and NREL (2019b) with Brattle analysis.

Notes: Historical estimate assumes Bloomberg NEF battery pack cost estimate plus a constant non-pack cost estimate of approximately $170/kWh. NREL costs are for a 4-hour, utility-scale lithium ion battery.

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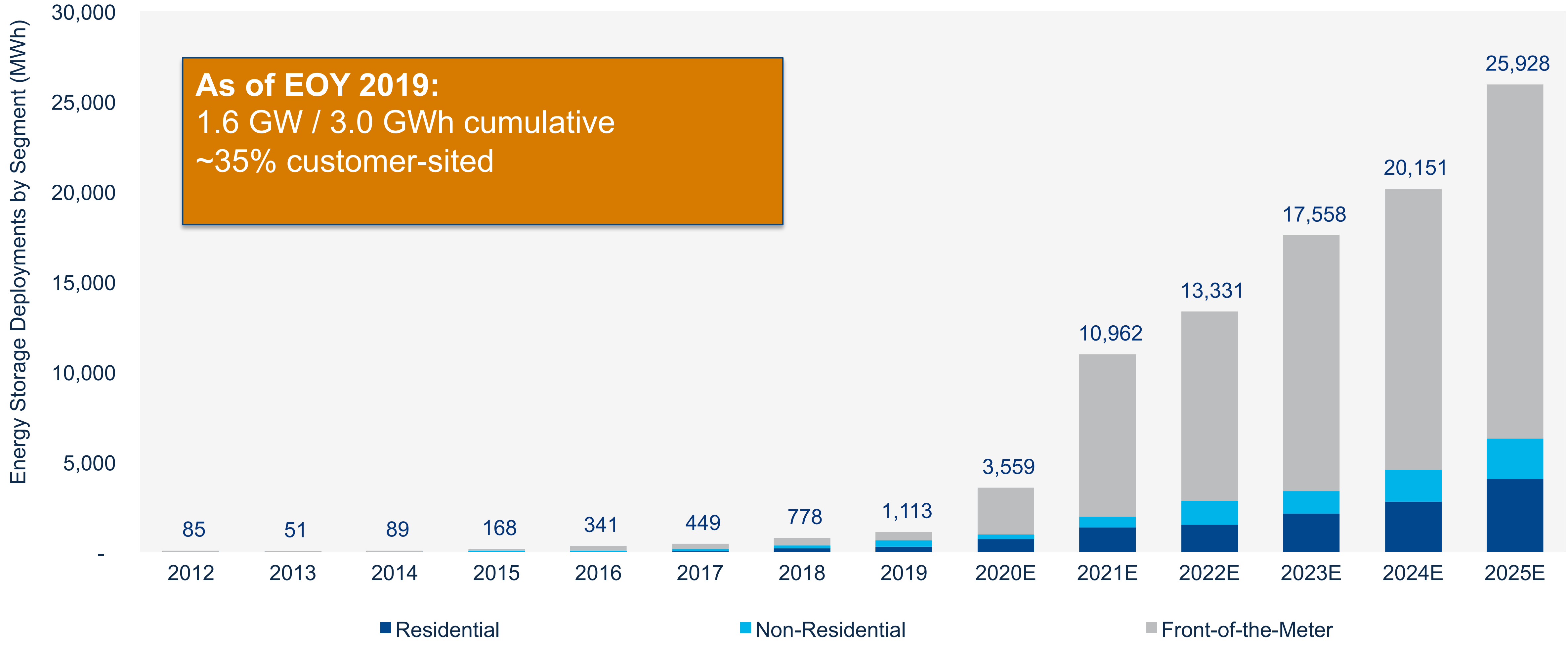
U.S. market will reach 26 GWh annually by 2025

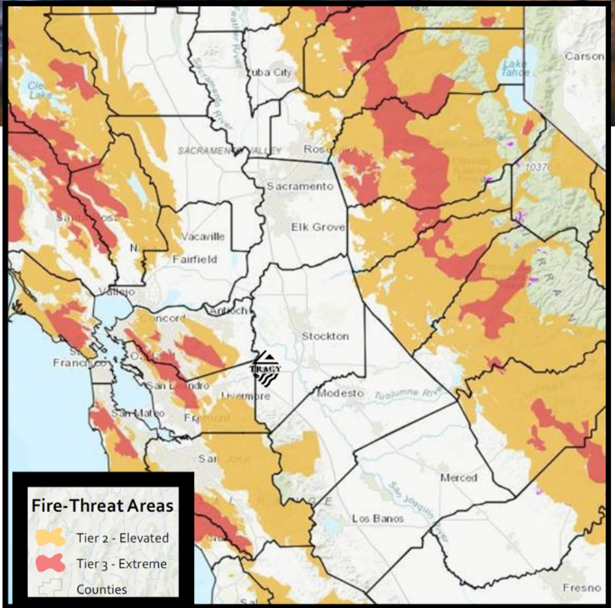
Longer durations for standalone and solar paired projects will drive 7x market growth compared to 2020

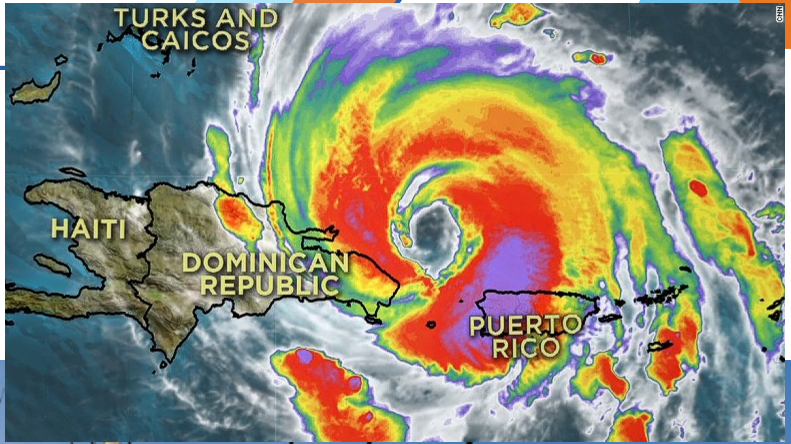
U.S. energy storage annual deployment forecast, 2012-2025E (MWh)



Source: Wood Mackenzie Power & Renewables


PG&E
PUBLIC SAFETY
POWER SHUT OFF


Fire-Threat Areas
Tier 2 - Elevated
Tier 3 - Extreme
Counties
Sacramento
Elk Grove
Vacaville
Fairfield
Stockton
Modesto
Merced
Los Banos
Fresno
Carson
Livermore
SACRAMENTO VALLEY


TURKS AND CAICOS
HAITI
DOMINICAN REPUBLIC
PUERTO RICO

Storage and Resilience

- **Main challenges for storage as resilience**
  - Unclear method to value resilience
  - Interconnection processes
  - Delays & falling budgets due to COVID
- **State policies driving opportunities**
  - California Self-Generation Incentive Program + Microgrid Proceeding as precedents
    - Appropriately large incentives to vulnerable communities (low/mod income, fire risk)
    - Streamlining interconnection applications for key resiliency projects
    - Accelerating certain pre-approved interconnection designs
    - Revise Net Energy Metering (NEM) tariffs to enable storage import from grid + removing storage sizing limits
  - Adoption of Net System Capacity and other interconnection improvements in Nevada, Maryland, etc. as precedents
- **Federal policies driving opportunities**
  - FEMA Building Resilient Infrastructure & Communities Program to drive federal funds, spur state/local planning
    - Requirement to allocate 6% of disaster spending to pre-disaster mitigation funds ($300MM in FY20)
    - Solicitation to open Fall 2020; opportunity for private developers to partner with state/local governments or communities
  - Opportunity Zone financing may hold promise
    - IRS guidance on OZ Financing of real estate improvements include solar-storage equipment

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Storage as Peaker Replacement

Kauaii Island Utility Cooperative
20 MW / 100 MWh battery

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ENERGY STORAGE

Southern California Edison Picks 195MW Battery Portfolio in Place of Puente Gas Plant

How a California community succeeded in pushing for a reliability fix that will see the installation of storage projects rather than a natural-gas peaker plant.

JULIAN SPECTOR | APRIL 25, 2019

ENR Engineering News-Record

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Power & Industrial

Batteries Edge Out Natural Gas Peaking Plants in Arizona RFP

March 20, 2019

A recent announcement by electric utility Arizona Public Service could mark the tipping point in the way utilities think about building resources to meet peak demand.

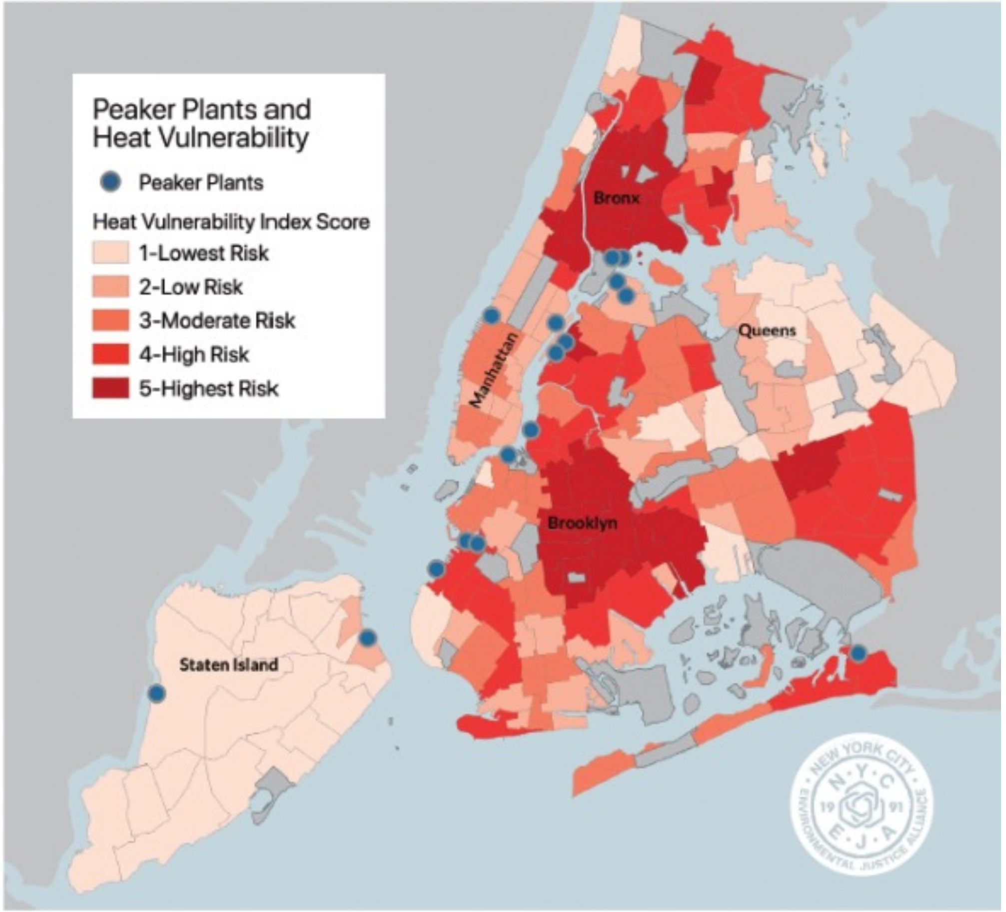
"We believe now that utility-scale battery storage, from a technology standpoint, is sufficiently viable to begin to displace, if you will, what has been virtually exclusively natural gas as that flexible, ramping, backstop resource."

-- Daniel Froetscher, VP of Operations, APS

AES Alamitos (COD Jan 2021)
100 MW / 400 MWh battery

Storage and Equity

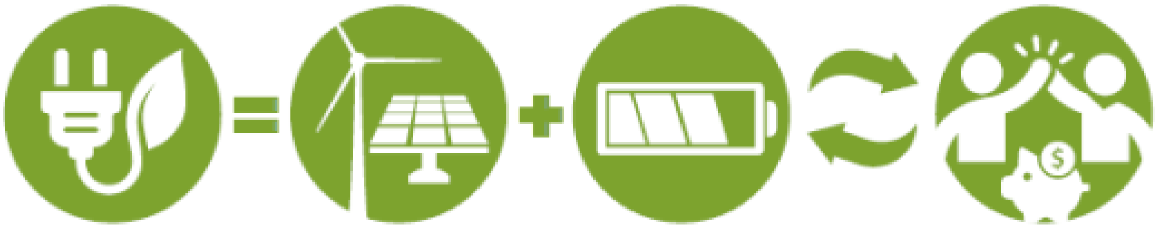
Map of New York City Peaker Plants and Heat Vulnerability Index



Source: NYC Environmental Justice Alliance (Using data from the NYC Department of Health and Mental Hygiene, the New York State Department of Environmental Conservation, and the New York Independent Systems Operator)

- **Storage can replace polluting peaker plants**
  - DER storage can make community members part of the solution

A Better Way to Meet Peak Demand



Peaker Plant Alternatives
Due to significant cost declines for renewable generation and energy storage technologies, fossil-fueled peakers can now be economically replaced by cleaner technologies.

Local Renewables
Renewable resources, both large-scale solutions like offshore wind and small-scale solutions like rooftop solar systems, can be installed in many locations where local energy generation is needed most.

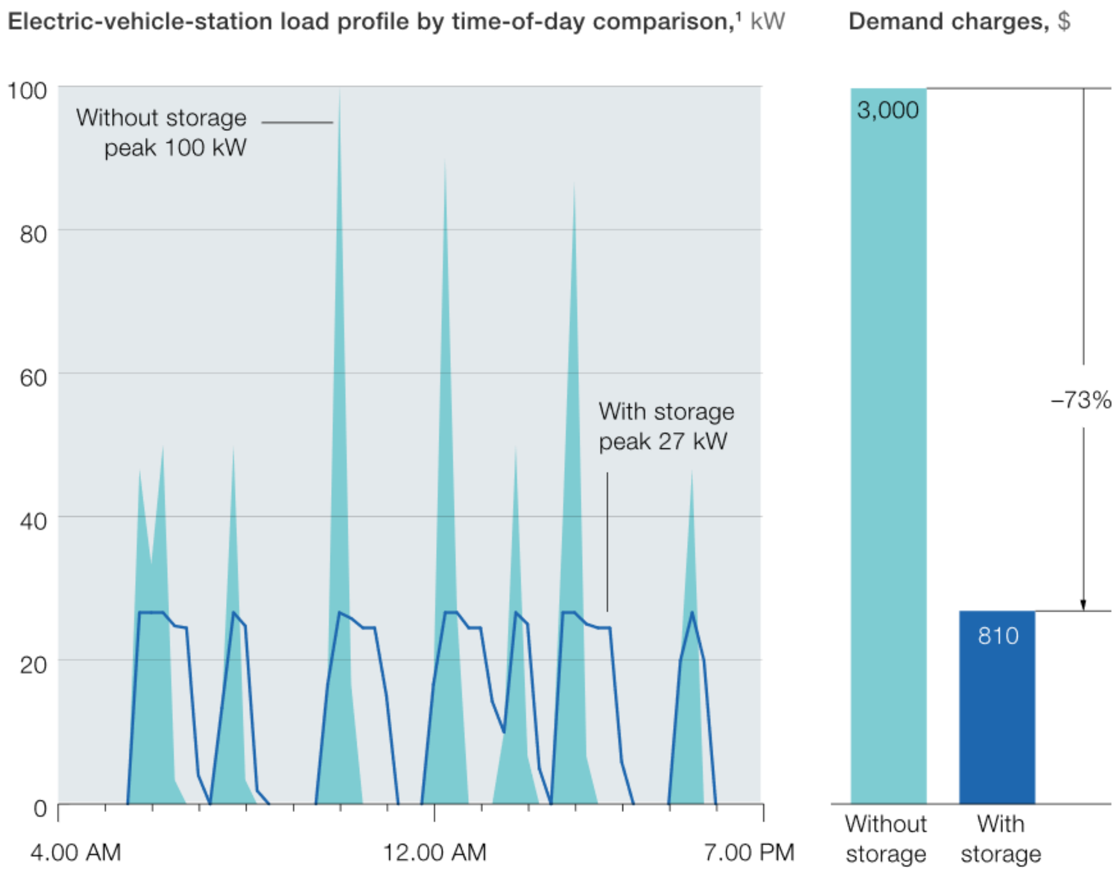
Battery Storage
Battery storage technologies can save electricity generated by wind and solar to be used during times of high demand—delivering critical peak power when the grid needs it most and providing lucrative revenue opportunities for battery system owners.

Community Power
Local renewable resources and battery storage can be combined and aggregated to provide a cheaper, cleaner, and more efficient alternative to fossil-fueled peakers. Unlike big power plants, these distributed resources offer opportunities for community ownership and local wealth creation, providing benefits to communities instead of causing them harm.

Storage in transport electrification

- **Vehicle/vessel/port electrification reduces local emissions**
- **Storage needed to mitigate grid impacts of DC fast-charging**


EVgo 30 kW / 50 kWh 2nd life batteries for DC-fast charging application



[1]This assumes (i) the station has four direct-current fast-charging 50 kW chargers; (ii) 11 charging sessions occur during the time period profiled (4 AM to 6 PM); (iii) there is at least one instance where two cars charge simultaneously; (iv) the demand charge rate is $30 per kW; and (v) the battery-storage system is 150 kWh and can discharge at up to 75 kW.

McKinsey&Company

Storage in rural electric infrastructure

- **Rural communities tend to have lower electric reliability—storage being used often as a non-wires alternative**
- **Examples**
- APS (Arizona): Punkin Center 4 MW storage avoids transmission upgrade for rural communities
- HECO (Hawaii): 1 MW aggregation of customer-sited storage providing distribution system stability across island grid
- National Grid (New York): Nantucket Island 6 MW, 8-hr storage to avoid new undersea cable & island resilience
- Duke (North Carolina): Hot Springs 4 MW storage as part of rural community microgrid

Takeaways

- **Key policy issues to enable storage for resilience and equity**
  - Interconnection reforms
  - Valuation of resilience & public health in planning processes
  - Integrating storage into resilience planning / disaster preparedness
  - Budgets to spur development in EJ communities

- **ESA stand by to help state energy offices with expertise, examples, and connections to industry members**

Questions? Feedback?

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PARKING LOT

California SGIP Equity Budget

- **Equity budget has been recently reworked, especially for resilience in response to PSPS challenges**
  - $100MM Equity Resiliency Budget category with a higher base incentive rate for Steps 3-5

Discharge Duration (Hours)	Percent of Base Incentive (Current)	Percent of Base Incentive (New)	Equity Incentive Rate (Old)	Equity Incentive Rate (New)	Equity Resiliency Incentive Rate (New)
0-2	100%	100%	**$0.50/Wh**	**$0.85/Wh**	**$1.00/Wh**
2-4	50%	100%	$0.25/Wh	$0.85/Wh	$1.00/Wh
4-6	25%	50%	$0.125/Wh	$0.425/Wh	$0.50/Wh
6+	0%	0%	$0.00/Wh	$0.00/Wh	$0.00/Wh

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California Microgrids Proceeding

- **SB 1339 requires microgrid promotion**
- **Three tracks to microgrids rulemaking R. 19-09-009**
  - Track 1: fast-track, near-term solutions for 2020 summer
  - Track 2: develop longer-term standards, protocols, rates/tariffs, etc
  - Track 3: ongoing implementation & resiliency planning
- **Track 1 concluding with several items**
  - Streamline interconnection applications for "key resiliency projects"
  - Accelerate certain pre-approved interconnection designs
  - Revise Net Energy Metering (NEM) tariffs to enable storage import (but not export) + remove storage sizing limits

- **Utilities have proposed resilience strategies**
- PG&E
  - permanently enabled Distribution Generation-Enabled Microgrid Services program ("DGEMS")
  - temporary generation program to provide mobile, temporarily sited distribution generation at substations, mid-feeder line segments serving commercial corridors and commercial facilities, and single-customer critical facilities during PSPS events
  - Community Microgrid Enablement Program
- SCE
  - 2020 Microgrid PSPS pilot program
  - continuing microgrid and microgrid-related activity currently in development
  - subsidies for battery back-up solutions for income-eligible, critical care residential customers
  - customer resiliency equipment incentive pilot program
- SDG&E
  - Local Area Distribution Controller

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BTM Storage Interconnection

- **Key determinant of policy success in promoting BTM storage is interconnection**
  - Storage often not explicitly contemplated in regulations
  - Some states have recently updated rules for storage; many more yet to go
  - Generally occurs in context of solar + storage

	Finalized							Under Development			
	Maryland	New York	Hawaii	Nevada	Arizona	Minnesota	California	Colorado	Michigan	Massachusetts	North Carolina
Generator definition	x	x	x	x	x	x	x	TBD	TBD	TBD	x
Inadvertent export	x	x	x	x	x		x	TBD	TBD	TBD	TBD
Net nameplate capacity	x	x		x	x			TBD	TBD	TBD	TBD
Proposed use	x							TBD	TBD	TBD	TBD

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NARUC Report on Value of Resilience

"Each of these options has its own sets of tradeoffs and potential limitations. The difficulties involved in valuing resilience relate directly to the challenges inherent in analyzing high-impact, low-probability power interruption events. Regulators seeking to evaluate resilience investments will need to grapple with these challenges against the backdrop of increasingly severe threats to the electricity grid."

Case Study	Method	Tool	Duration	Scalability	Ease of Use	Scope of Outputs
Solar + storage for critical infrastructure (Section 4.2.1)	Stated preference: Contingent valuation	ICE Calculator	• U.S. data sets are for interruption durations < 1 day • Limited customer experience with black sky events	Scalable from facility to national level	• ICE calculator available online • New surveys are resource intensive	• Well established in regulation • Does not consider spillover effects
The value of microgrids for critical services (Section 4.2.2)	Revealed preference: Damage cost	IEc Model (FEMA BCA tool)	• Can account for longer duration interruptions • Difficult to account for non-linear effects of long-term power interruptions	Scalable to different geographic levels	• Depends on damage metric used • FEMA BCA tool available online	• Depends on damage metric • Value of critical services may not be in-scope for regulators
Microgrids for community economic security (Section 4.2.3)	Input-output analysis	IMPLAN	• Can analyze long-term disruptions • Static models do not fully capture long-term shocks	• Effective for regional analysis • Difficult to scale to facility level	• IMPLAN commercially available • Other economy-wide approaches are more complex	Economic indicators may not be in regulatory scope
Microgrids for military bases (Section 4.2.4)	Revealed preference: Defensive behavior	Generator cost calculation	Most resilience measures are not purchased for long duration power interruptions	Difficult to scale to larger geographies	Market data is available	• Directly related to energy investment • Does not consider spillover effects