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Energy Storage Data and Analysis Needs: Industry Perspective

EIA Energy Storage Workshop

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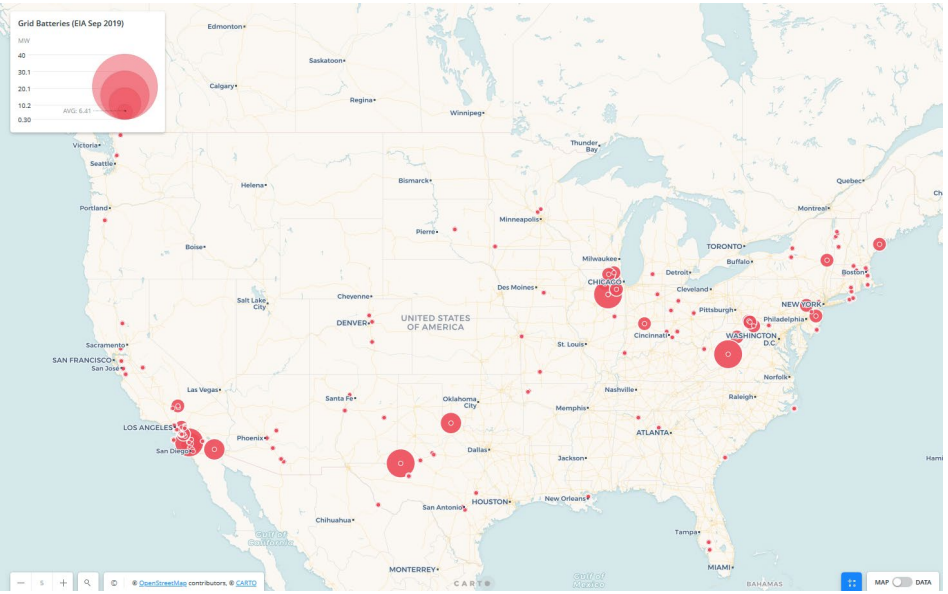
www.energystorage.org

Data/Analysis Questions for Industry

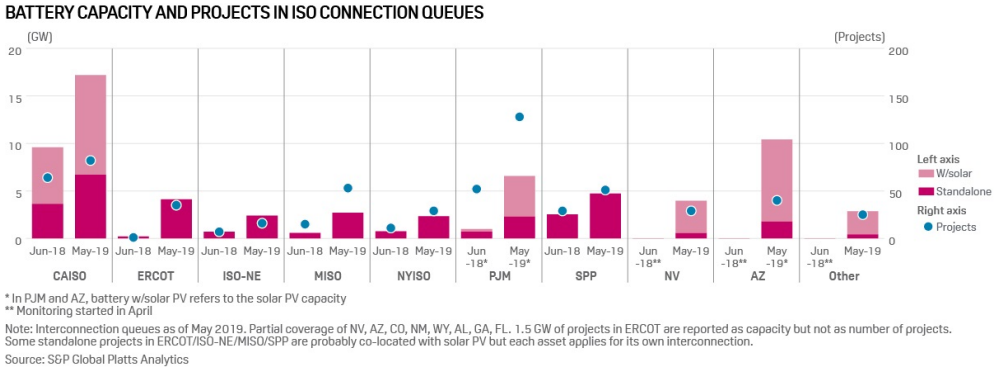
- **From policymakers**
  - How much storage is deployed? How much is planned?
  - What is the cost of storage?
  - How much storage do we need?
  - What is the emissions impact of storage?
  - What are the system / ratepayer benefits of storage deployment?
- **From grid operators**
  - What is the contribution of storage to resource adequacy?
  - What is the value of storage services?
- **From others**
  - What is the cost structure of storage?

Deployment Data Sources

- **Deployment data**
  - EIA 860-M
  - WoodMackenzie
  - Platts
  - Utility IRPs
  - State Program Results
  - RTO Interconnection Queues
- **Key issues**
  - Lack of capture of key details
    - MWh
    - Hybridization
  - DER storage often overlooked
    - BTM hard to capture
    - Dx infrastructural storage not “generation”
    - Unclear reporting lines for leased projects
- **Recommendations**
  - Include MWh in reporting
  - Develop methods for estimating DER storage via state energy offices, utility interconnection, other sources
  - Track utility IRPs and RTO interconnection queues for forward estimates



State	Utility	IRP Year	Storage Proposed	Timeline
IN	IPL	2016	833	over 20 years
HI	HECO	2016	535	2020
OR	PGE	2016	39.8	2020
KY	Kentucky Power	2016	10	over 10 years
CO	Xcel	2016 (2018 update)	275	2030
WA	Puget Sound	2017	75	2029
NC	Duke Carolinas	2017	75	2019-2021
AZ	UNS Energy Corp	2017	20	2028
WA	Avista	2017	5	2029
OR	PacifiCorp	2017	4	2020
MI	Consumers	2018	450	2040
NC	Duke Carolinas & Duke Pro	2018	290	2026
NM	El Paso Electric	2018	115	2035
NV	NVE	2018	100	2021
IN	NIPSCO	2018	92	2023
FL	FPL Energy	2018	50	2020
VA	Dominion	2018	30	2025
VA	Appalacian Power	2018	10	2025
NV	NVE	2019	590	2023
AZ	APS	2019	500	2025
FL	FPL Energy	2019	409	2022
PNM	New Mexico	2019	130	2023
GA	Georgia Power	2019	80	2024
OR	Idaho Power	2019	60	2034-2038
MI	Indiana Michigan Power	2019	50	2028
Multi	PacifiCorp	2019	2,800	2038
Total			**7,658**	



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Cost Data Sources

- **Cost series data**
  - NREL ATB
  - WoodMackenzie
  - Lazard
  - BloombergNEF
  - Utility IRPs
  - Utility RFP Results
  - State Program Results
  - Published PPAs
- **Key issues**
  - Lack of empirical data series
  - Lack of standard reporting
    - Hardware vs. installed
    - Project boundary (e.g., interconnection)
    - Price vs. cost
    - Capex vs. LCOE
  - Insufficient reflection of variety of characteristics
    - Lithium variants
    - BTM vs. Dx-connected vs. Tx-connected
    - Standalone vs. hybrid
  - Lack of data on early techs (e.g., Zn, V, etc)
- **Recommendations**
  - Create empirical report (similar to Tracking the Sun, etc)
  - Establish methods for breaking out storage costs from hybrid projects

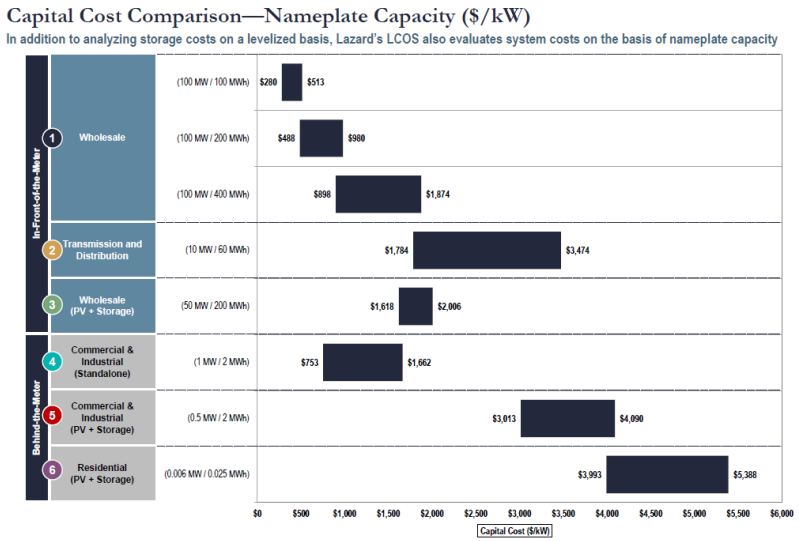
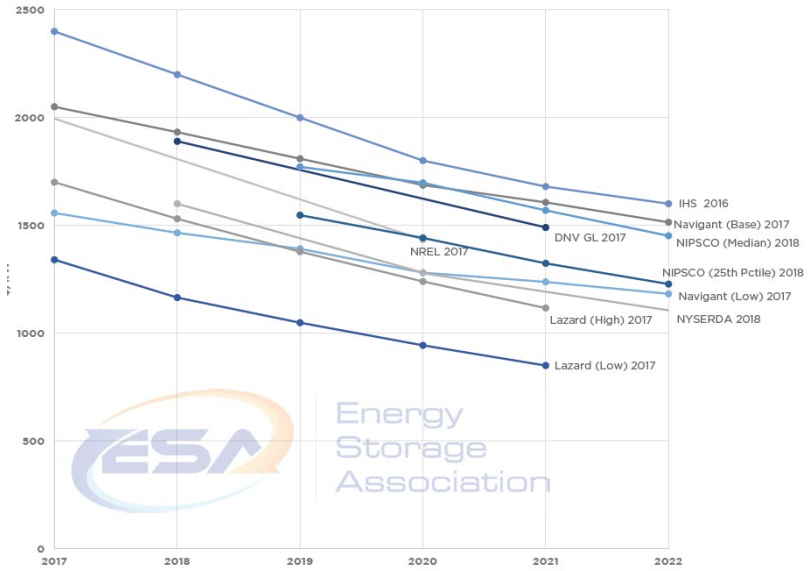
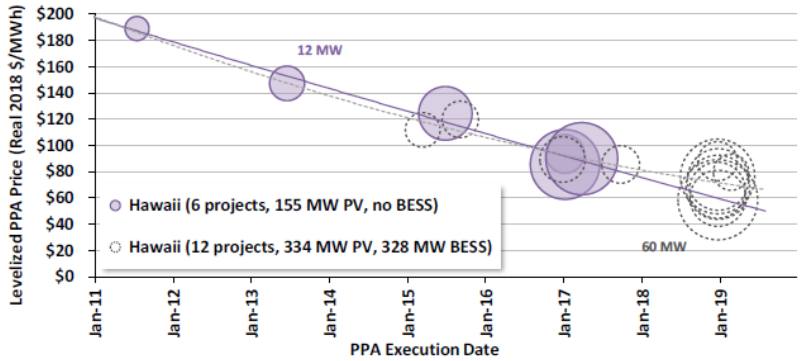


Figure 1: Installed Costs of Large-Format Lithium-Ion Battery Energy Storage, 4-Hour System[5]





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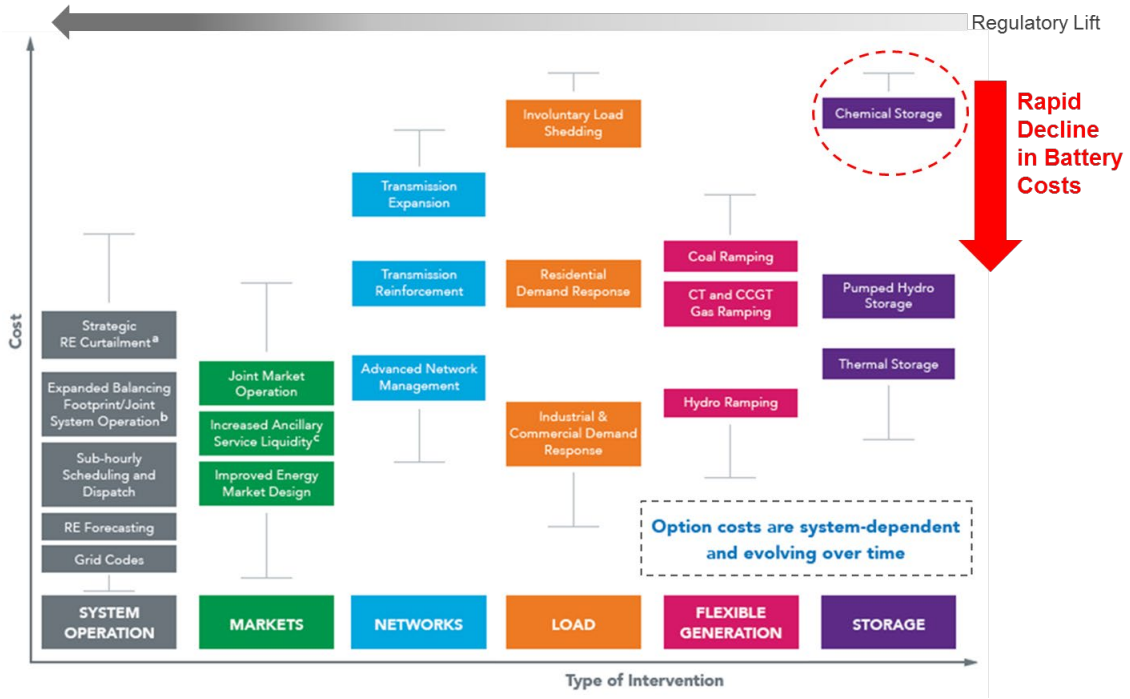
Analysis of System Need

- **Different rationales for "need"**
  - For an X% clean power system?
  - For economic replacement of retiring capacity?
  - For avoiding curtailment?
  - For electrification of transportation / T&D infrastructure?
- **Assumptions affect "need"**
  - What price/duration/functions of storage are assumed available?
  - What substitute technologies are assumed available?
- **Recent analyses of note**
  - NREL
  - Utility IRPs
  - NGO (GridLab, UCS)
  - Academic
- **Recommendations**
  - Study storage in a standalone context, not only as renewable hybrid
  - Study storage in different clean energy mixes (not just high RE)



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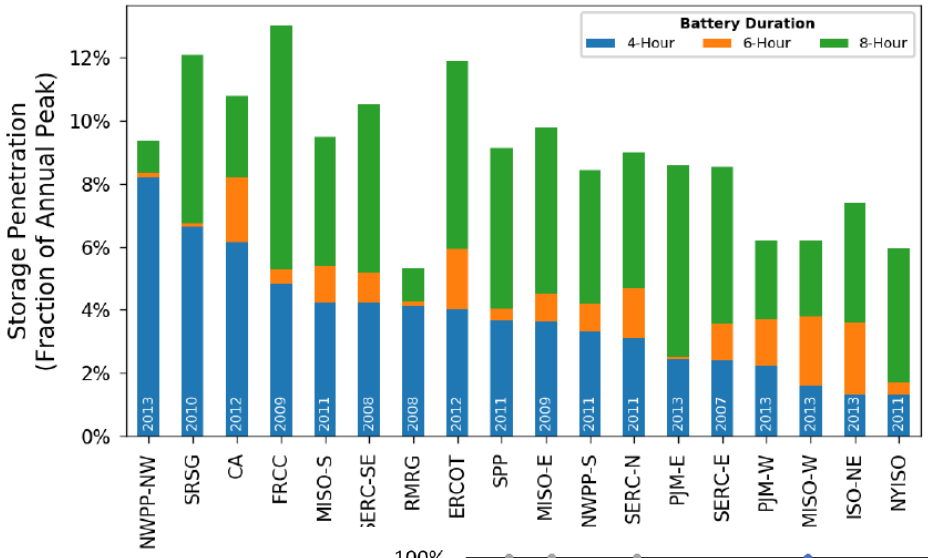
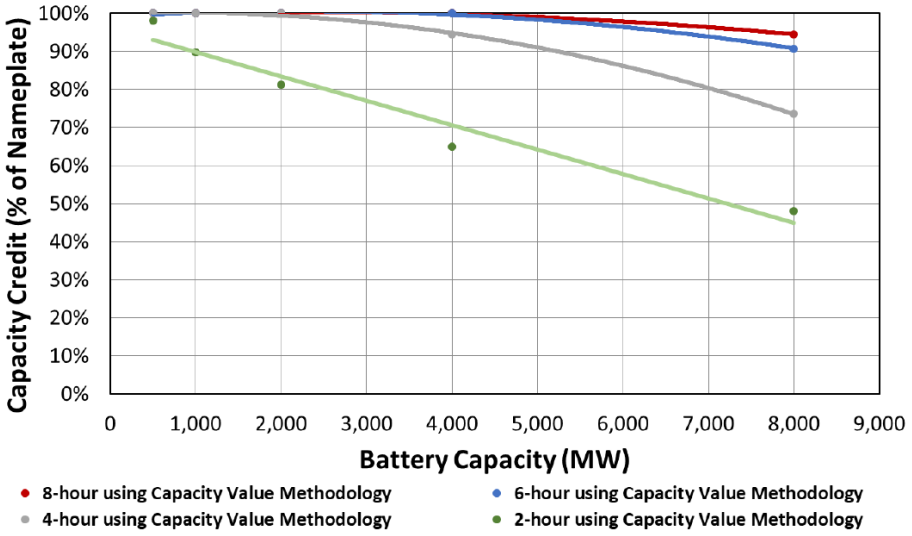
Analysis of Reliability Contribution

- **Recent analyses**
  - NREL
  - NYISO, SPP, CAISO ELCC studies
- **Key issues**
  - Existing analytical methods can capture storage but may be computationally intensive (e.g., ELCC)
  - Significant assumptions involved in analytical methods
    - Sensitive to dispatch assumptions
    - Contribution of storage changes with supply mix, load profile → requires forecasting of system
  - Lack of hybrid resource approach
    - Hybrids not "standard"
  - Utility planning models still catching up
    - Rarely use sub-hourly modeling (or not even chronological hourly)
  - Characteristics may not be captured in reliability analyses (e.g., response time / availability)
- **Recommendations**
  - Undertake ELCC analysis across grid regions, determine need for longer-duration storage
  - Develop hybrid resource capacity qualification guidelines
  - Develop metric to reflect system flexibility needs for reliability, akin to LOLE convention





Valuation Methods

Quantification robustness varies

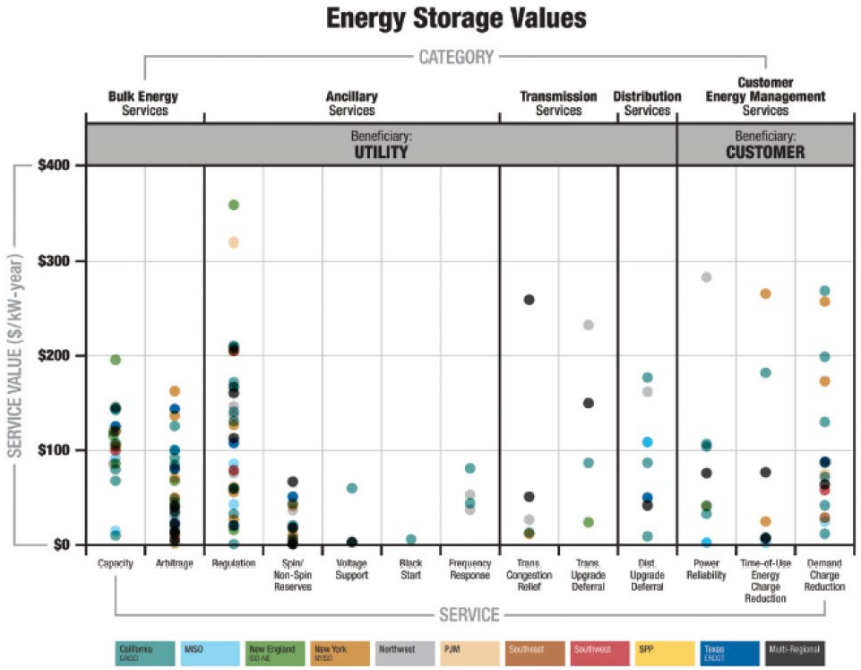
- Established
  - Wholesale Services (Energy / Capacity / Ancillary Services)
  - Demand charge management
- Less established
  - Avoided Tx/Dx
  - Avoided emissions
  - Price effects
  - Voltage/local reliability
- Not yet established
  - Resilience
  - Option value

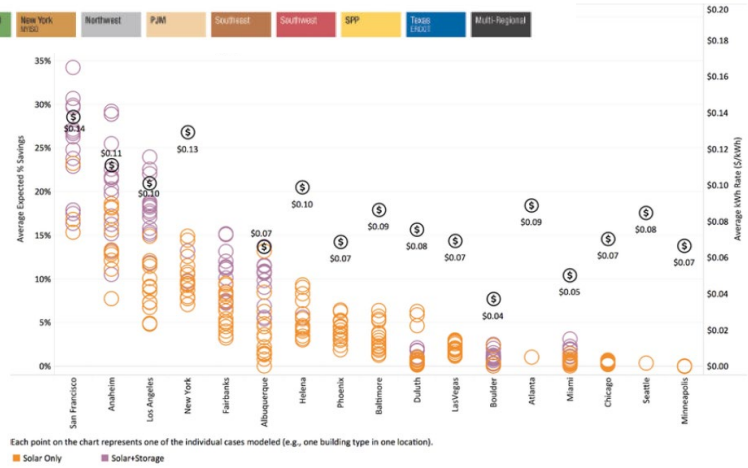
Many actors working to establish methods

- State PUCs / Energy Offices
- EPRI
- NSPM for DER

Recommendations

- Collect catalogue of valuation methods for core power system benefits
- Develop menu of methods & guide for selecting appropriate method for valuing resilience
- Develop option value method for storage as non-wires alternative





Emissions Analysis

- **Storage can reduce emissions via several paths**
  - Avoiding fossil generation (peakers) & related infrastructure
  - Integrating higher levels of renewables with deliverability
  - Enabling more rooftop solar, EVs, and other DERs
  - Making the grid more efficient
- **Recent studies on negative emissions impacts**
  - Often based on unchanging system (no coal retirements)
  - Round-trip losses offset by enabling greater RE deployment
  - Models assume arbitrage behavior that may not reflect actual operations
- **Recommendations**
  - Conduct empirical study of storage impact on system dispatch and emissions
  - Create datasets on marginal unit GHG emissions for energy deliveries by location/hour/season
  - Develop analytical methods for non-GHG impacts (NOx, SOx, PM)

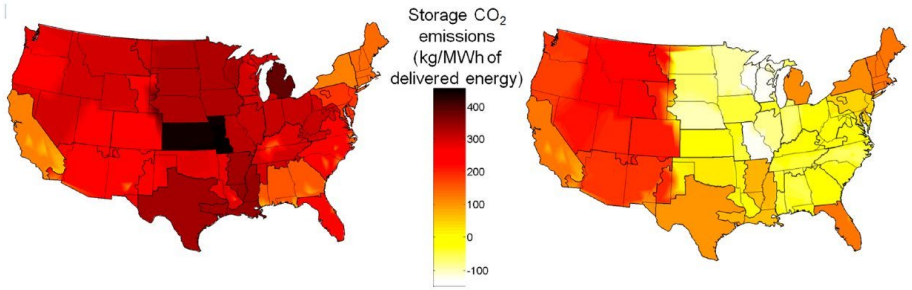


Figure 9. Average net CO_2 emissions resulting from the operation of the base-case storage device at 48 locations in the U.S. under perfect information on future electricity prices under 2014 MEFs (left) and under modified MEFs representing combined-cycle natural gas as the off-peak marginal generator (right). The storage parameters, prices, and operation are the same in both panels, but the MEFs for the right panel are modified so that the maximum emissions factor between 10 p,m, and 7 a.m. is 410 kg of CO_2/MWh. Regions that already have low marginal off-peak emissions (California, New York, and New England) have a very small shift. In the Midwest, however, storage goes from having the highest net emissions to having negative net emissions because it charges from efficient combined-cycle plants and displaces peaker coal and natural gas units.

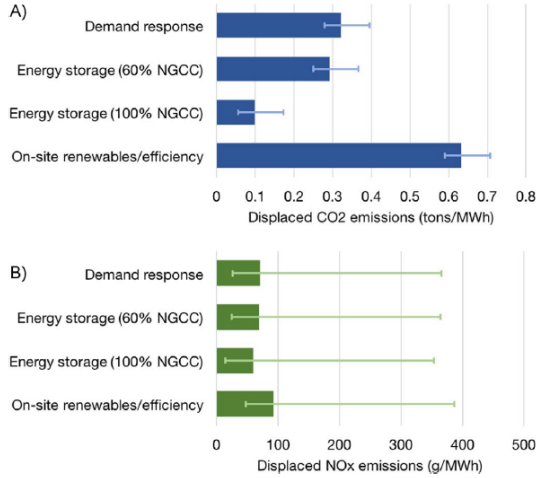


Fig. 7. Displaced peaker plant (a) CO_2 and (b) NO_x emissions for four technology sets: demand response shifting to nighttime load, energy storage shifting to nighttime load, energy storage charged with NGCC, and on-site renewables and efficiency. Greatest benefits are seen for on-site renewables and efficiency. The range bars mark the 5–95% range for peaker plants, illustrating the value of targeting high-rate emitters, particularly for avoiding NO_x emissions.

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System Benefit Analyses

- **Recent analyses to note**
  - Massachusetts DOER (2016)
  - NYSERDA (2018)
  - Virginia DMME (2019)
- **Can identify gap between system cost and value to system/ratepayers**
  - Informs state policy interventions
- **Can include non-traditional power sector considerations**
  - Jobs/economic development
  - Public health/environment
- **Recommendations**
  - Develop more robust data on jobs & economic activity from grid storage sector
  - Fund states to undertake and/or develop supporting methods for system benefit analyses

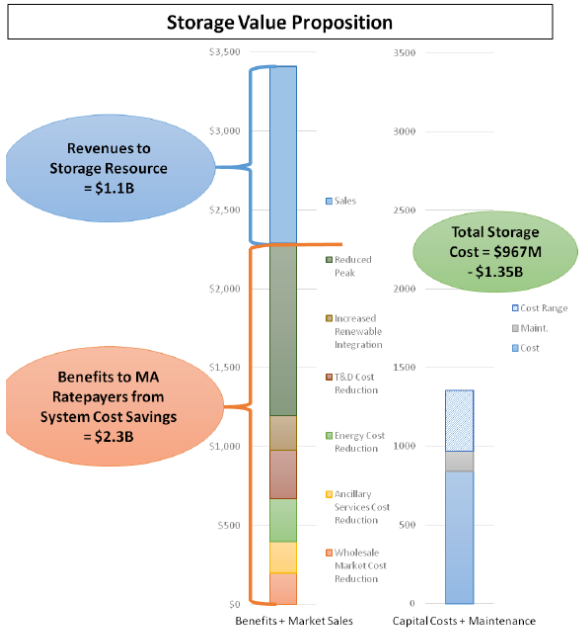


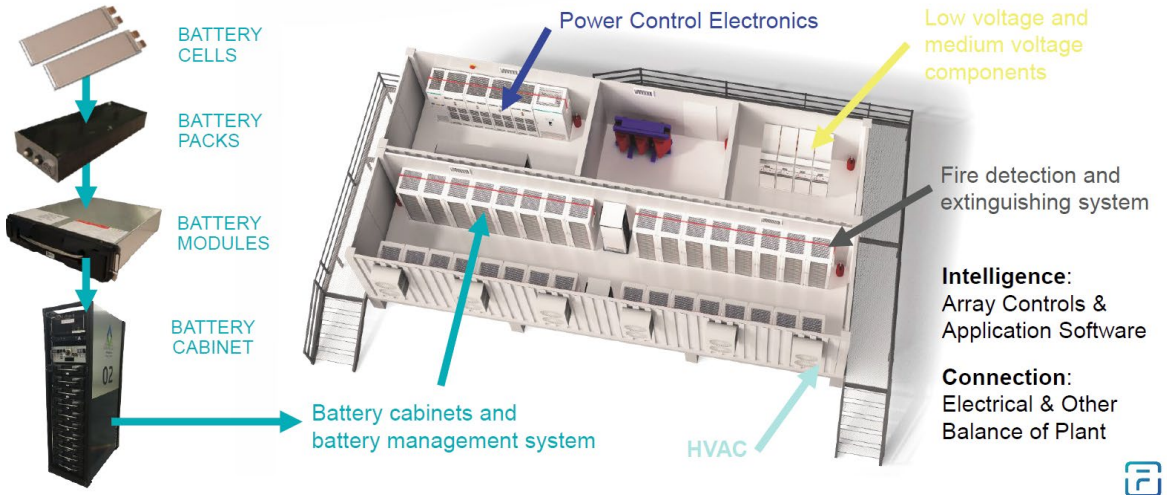
Figure 12: Storage Value Proposition

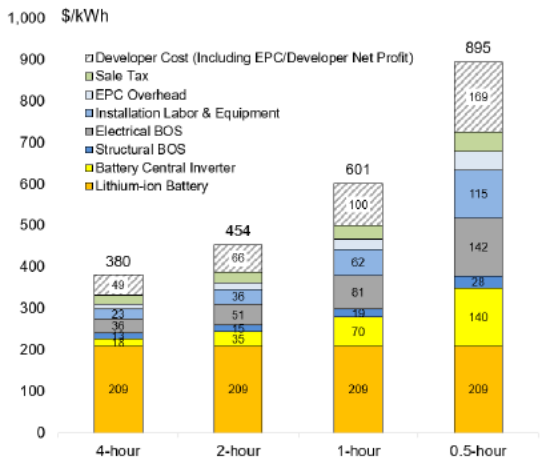
		1hr	2hrs	4hrs	10hrs
		2019			
Low Cost	Efficient Storage Level (MW)	110	113	84	0
	Annual Net Benefits ($M)	$ 4.99	$ 9.35	$ 6.36	$ -
High Cost	Efficient Storage Level (MW)	71	72	24	0
	Annual Net Benefits ($M)	$ 2.82	$ 5.28	$ 3.18	$ -
		2029			
Low Cost	Efficient Storage Level (MW)	961	1,123	970	356
	Annual Net Benefits ($M)	$ 29.93	$ 56.66	$ 58.04	$ 25.27
High Cost	Efficient Storage Level (MW)	397	396	329	9
	Annual Net Benefits ($M)	$ 19.93	$ 37.44	$ 25.30	$ (0.17)

gure ES-1. Summary of estimated potential electricity system benefits from energy storage deployed in ıe Commonwealth of Virginia. Results are summarized by High-Cost and Low-Cost scenarios for storage deployment and by duration of storage resources

Cost Structure

- **Understanding components can inform policy**
  - Focus of applied R&D
  - Better inform trade and industrial policies
  - Assist with standardizing cost reporting
- **Not yet well understood for non-battery technologies**
  - Critical for longer-duration storage technology analysis/planning





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Questions? Feedback?

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