



ENERGY STORAGE CHALLENGES

DOE Electricity Advisory Committee (EAC)
Rate-Tariff-Market Design Panel
February 20, 2018



QUANTA
TECHNOLOGY

Smart Solutions, Practical Results

Energy Storage is Building Momentum



Duke Energy's \$30 Million Investment in Battery Storage Is 'a Harbinger of Things to Come'

How can Tucson Electric get solar + storage for 4.5¢/kWh?

Subsidies and aggressive pricing assumptions are key to the success of the Arizona PPA price, analysts say

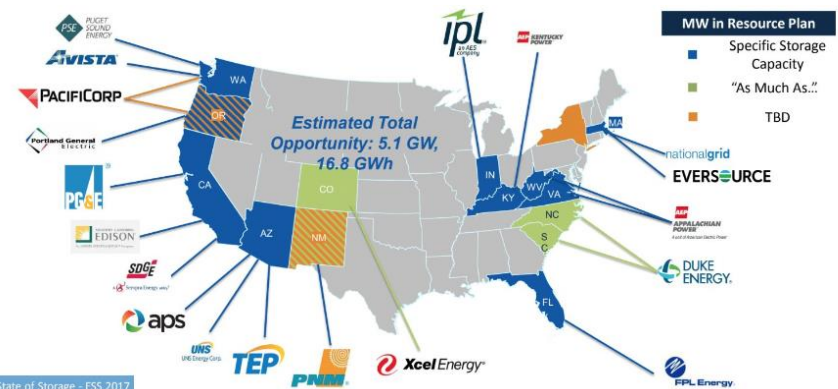
May 30, 2017



APS Buys Energy Storage From AES for Less Than Half the Cost of a Transmission Upgrade

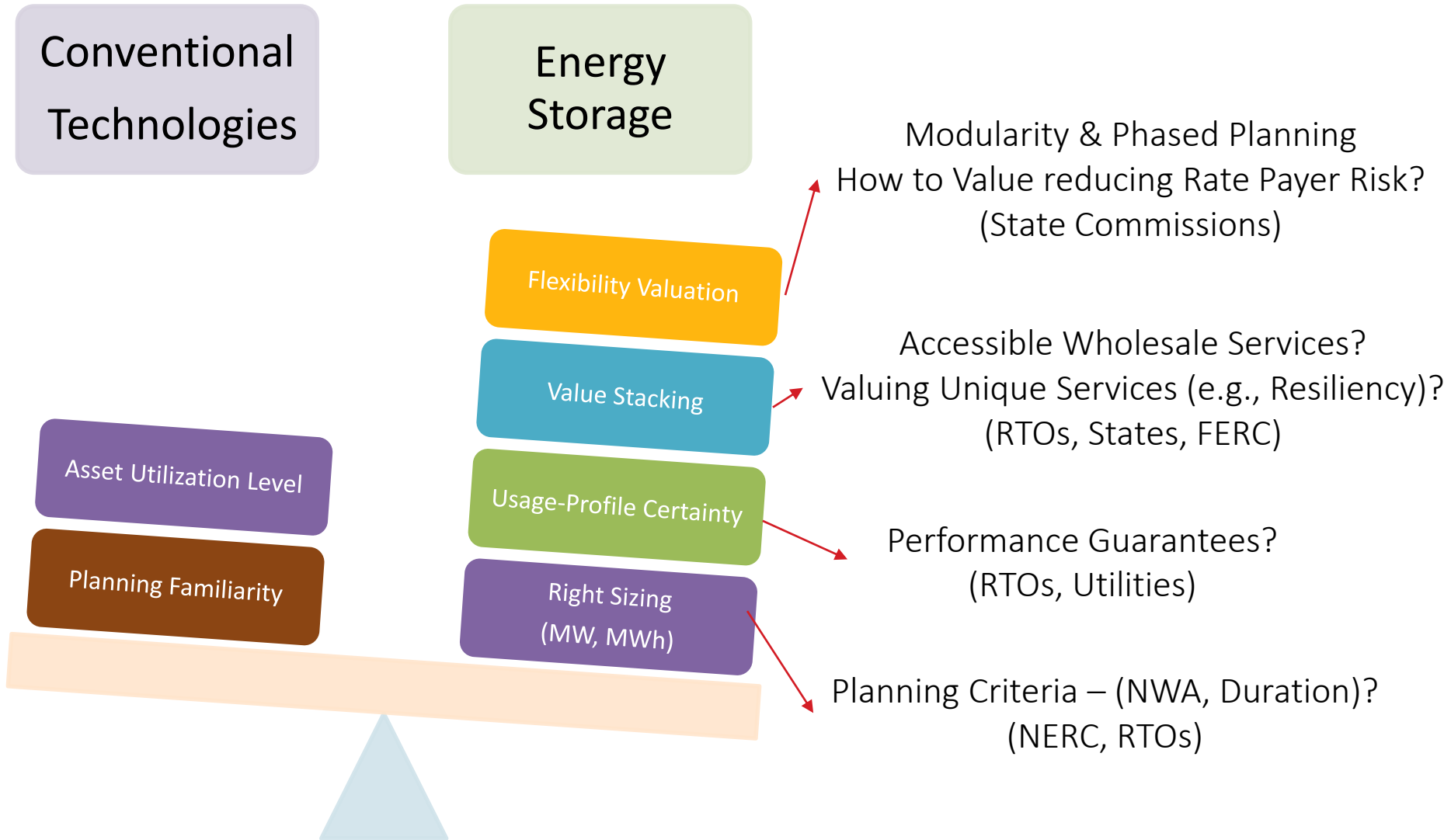
August 09, 2017

Energy Storage has Moved beyond DoE-driven Pilots!



Kann - State of Storage - ESS 2017

Competitiveness of Energy Storage Systems



Right Sizing

Regional Congestion Relief (PJM)

▪ Motivation

- Regional congestion costs the markets hundreds of millions of dollars per year
- Permitting and building new transmission can be lengthy and expensive
- Line capacity is not modular, and relieving moderate congestion may not be economical

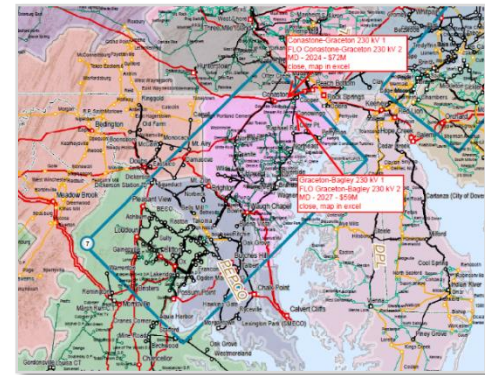
▪ Planning Considerations

- Congestion usually occurs after contingencies (N-1 or N-1-1)
- Siting and sizing energy storage
- Partial vs complete mitigation economics
- Simultaneous charging and discharging
- Market re-dispatch timing

▪ Case Study in PJM Region

- 230-kV congestion in PJM 2016 long-term market efficiency window
- Partial mitigation had B/C ratios ranging from 3 to 5 using 4-hour batteries

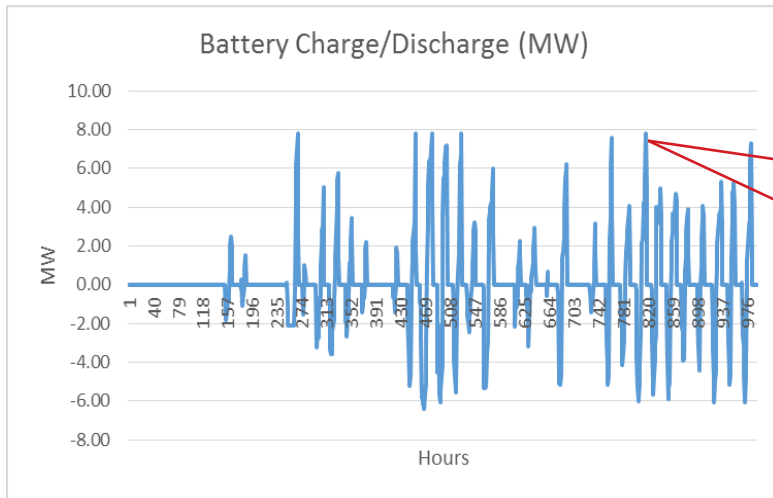
**What Storage Capacity (Hours) is Acceptable? 30min or 4 hours?
Significant Cost Impact!
Need Planning Criteria for NWA**



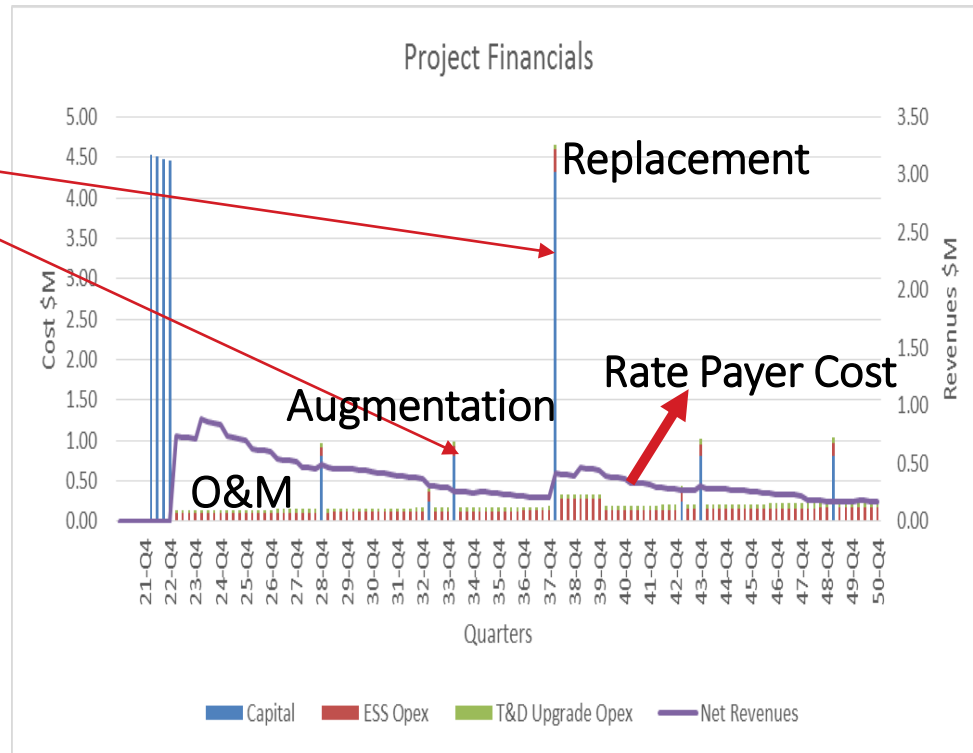
Siting and Sizing of Storage to Resolve multiple N-1 Congestions

Usage Profile – Cost Uncertainty

Asset Management



Cycles per Day?
Depth of Discharge?
Speed of Charge/Discharge?



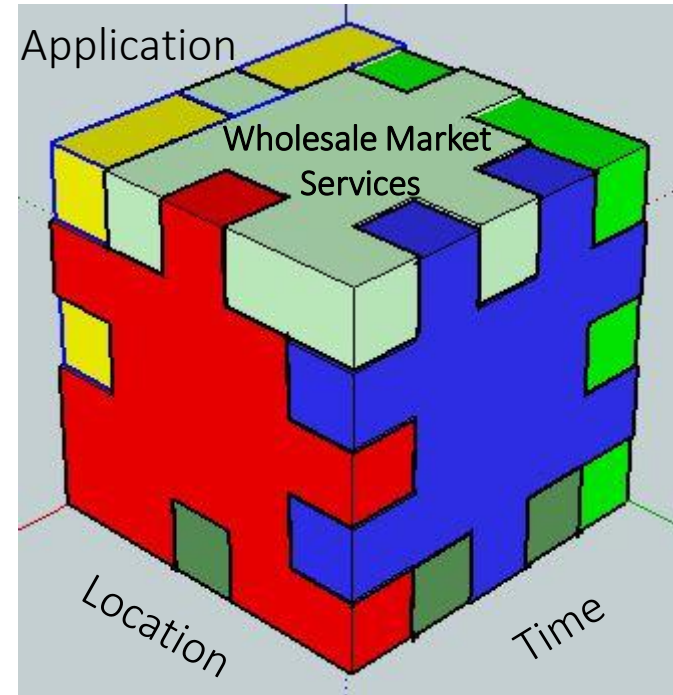
Uncertainty in Usage Profile is Costly to Rate Payers:

- Contracting and Performance Guarantees
- Warranty Cost
- Capacity Fading
- Asset Management Strategy and Cost

Value Stacking

Accessibility of Storage to Wholesale Markets & Valuation of Unique Services

- Access to Wholesale Market Services?
 - By Location: C-D-T-G
 - By Time: Day Ahead, Real Time, ..
 - Application: Reliability, Efficiency, Policy, ..
 - Which Market Services?
- Valuing System Resiliency:
 - Black Start
 - Islanding and Microgrids
 - Enable Clean Energy Future



California PUC adopts multi-use energy storage rules

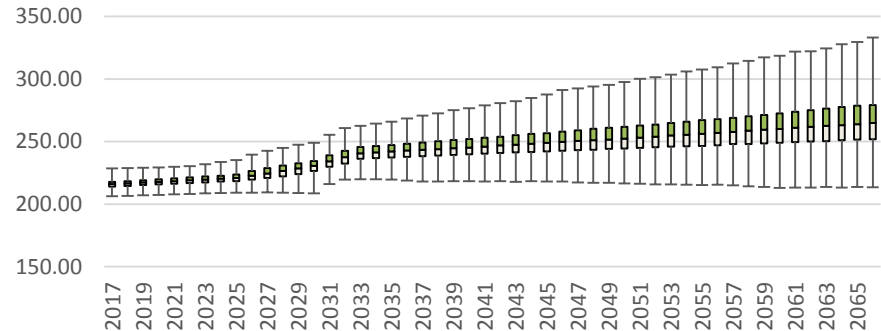
Clarity of Market Rules Important to Financial Viability

Flexibility Valuation

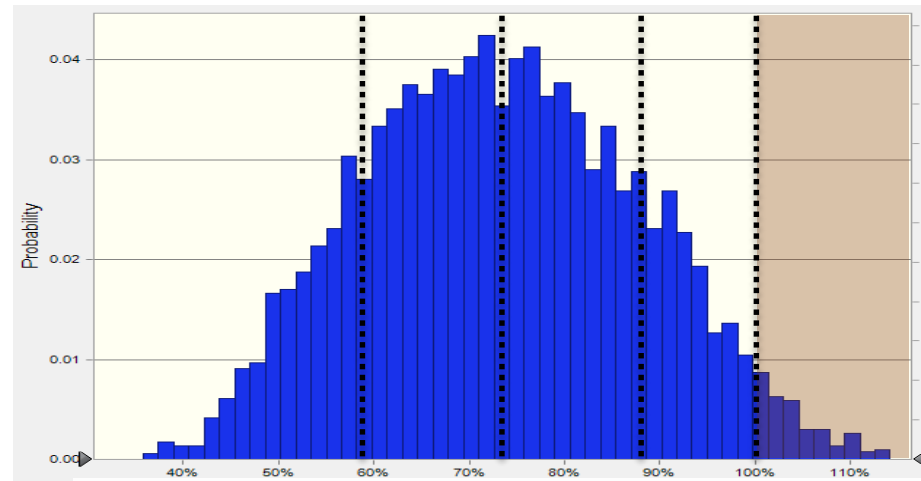
Phased Implementation Reduces Rate Payer Risk

- Storage Modularity Allows Phased Implementation:
 - As more information is available, storage size and asset management can be adjusted.
 - Reduced risk to rate payers of stranded or under utilized assets.

Load Profiles



How is the Storage Flexibility Valued?



Storage to Conventional Solution Cost Ratio

Conclusions

- Storage is not a traditional asset:
 - Not familiar to system planners
 - Offer both Similar and Unique attributes as Conventional Assets

- Enablers to Economic Viability of Storage:
 - Clarity in Planning Criteria impacts size and cost
 - Uncertainty in Usage Profile impacts performance guarantees and cost certainty
 - Access to markets and valuation of unique services crucial to business case
 - Asset flexibility and rate payer risk reduction is not recognized or compensated yet

Thank you!

Quanta Technology, LLC
4020 Westchase Boulevard, Suite 300
Raleigh, NC 27607



(919) 334-3000



quanta-technology.com



info@quanta-technology.com



Facebook.com/quanta-technology-LLC



[@QuantaTech](https://twitter.com/QuantaTech)



Linkedin.com/company/quanta-technology



QUANTA
TECHNOLOGY

Hisham Othman

HOTHman@Quanta-Technology.com