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Energy Storage Experience and Planning

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BOUNDLESS ENERGY℠

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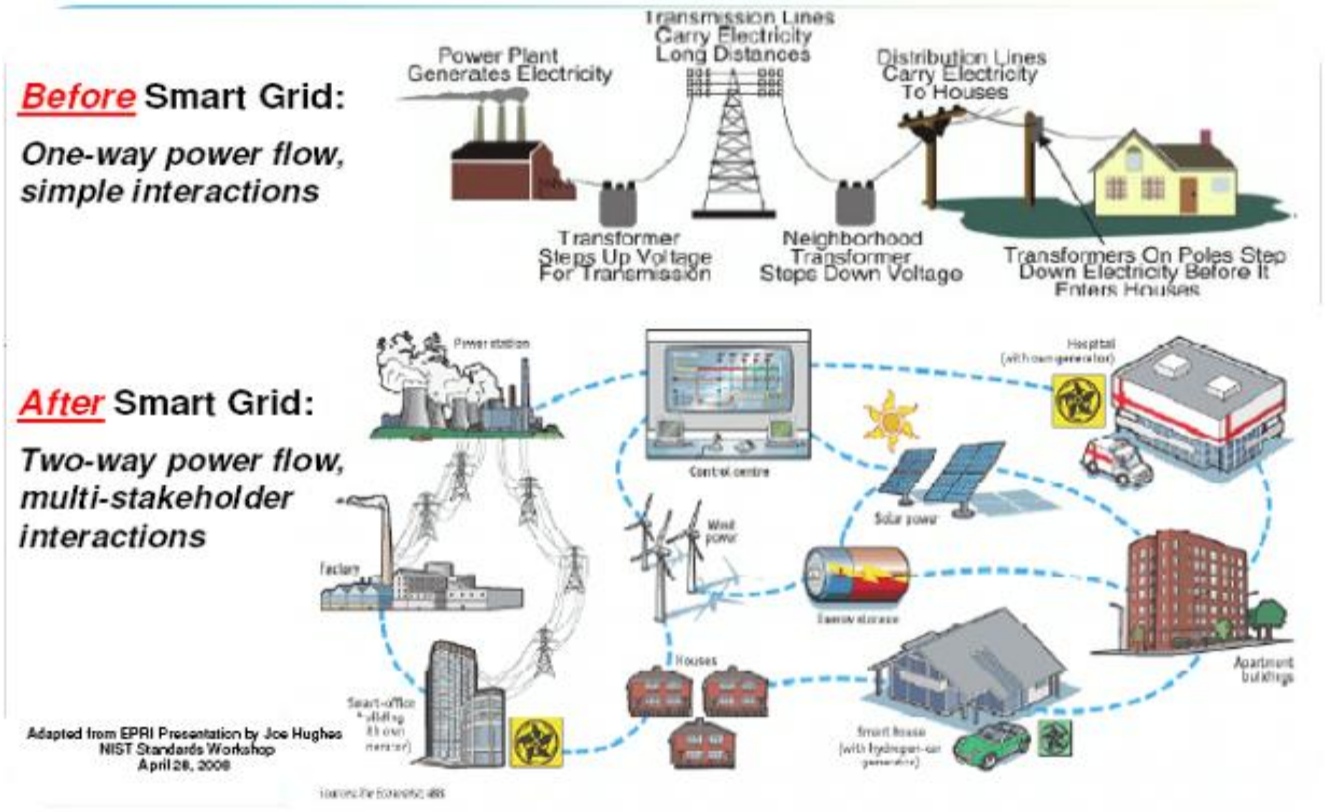
Evolution of the Electric Utility System



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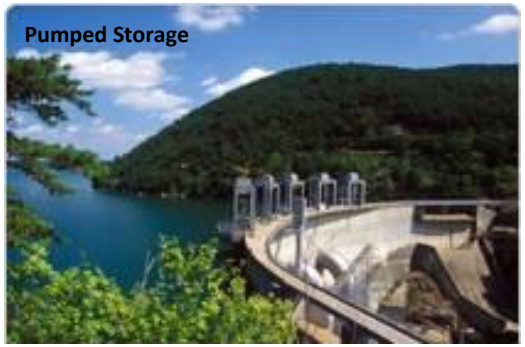
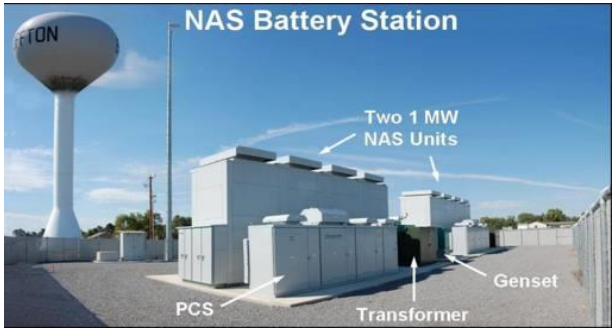
AEP's HISTORY WITH ENERGY STORAGE





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Energy Storage Deployments at AEP

- 1MW, 7.2MWh installed in 2006
  - Deferred substation upgrades
- 3 – 2MW, 14.4MWh commissioned in 2009
  - Demonstrated “load following” and “islanding (backup power)”
- 4MW, 25MWh substation commissioned in 2010
  - Islanding town of Presidio, Texas

The new ‘islanding’ feature is partially funded by DOE/Sandia

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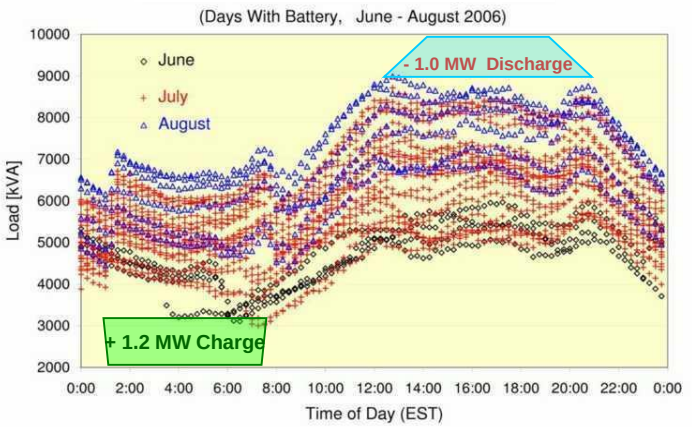
Peak Shaving Example

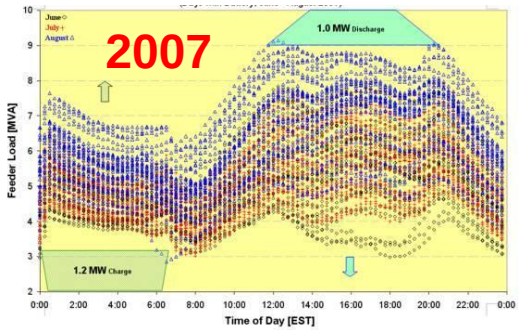
Scheduled trapezoidal Charge & Discharge profiles

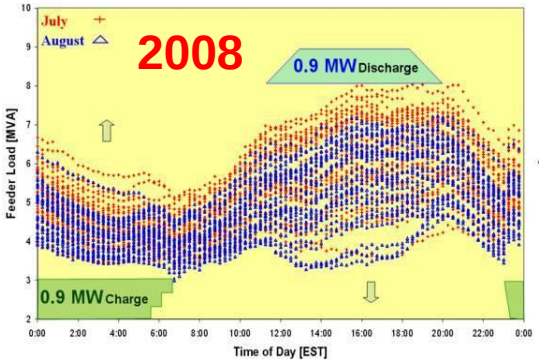
Summer Month Peak Days

Improved the feeder load factor by 5% from (75% to 80%)

2006







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Islanding Examples

	Event 1	Event 2	Event 3	Event 4
Location	Milton, WV	Milton, WV	Milton, WV	Milton, WV
Customers on Backup Power	700	700	700	700
Duration on Backup Power	1hr 17 mins	10 hours	4 hours	3hr 7 mins
Cause of Outage	Vehicle Accident	Electrical Fault	Fault	Fallen Tree
Date	Nov 2010	Mar 2011	Aug 2011	June 2012

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Frequency Regulation Update (Balls Gap Station- Milton, WV)

- Battery Capacity: 2MW, 14MW Hours
- Initial filing to include battery in 2016 PJM queue completed
- 1MW in 2016 after distribution line upgrade
- 2MW in 2017 after new Balls Gap 138/34.5 kV station completion
- Currently performing in the PJM Frequency Revenue Market

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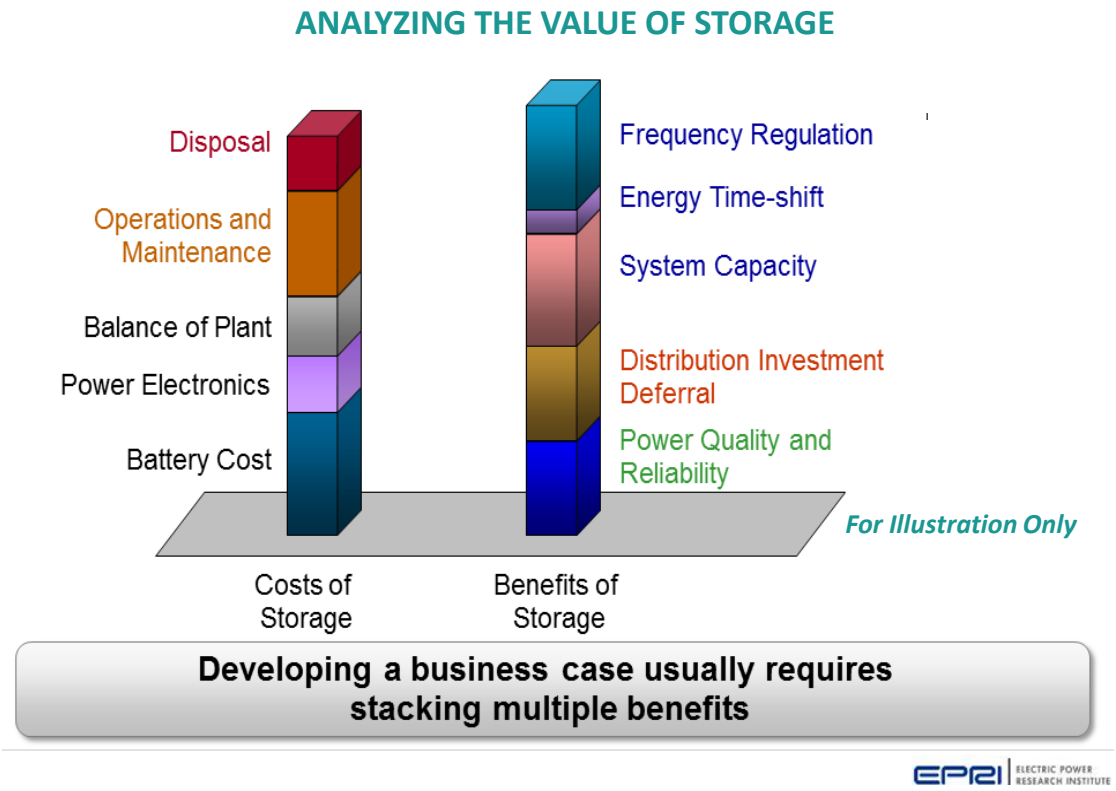
Energy Storage – Cost/Benefit



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Energy Storage - Capacity Deferral

- Low growth
- Traditional project is mostly capacity addition with little incremental reliability improvement (new station, transformer, feeders)
- Area not likely to get block loads
- Future load growth questionable
- Future T & D plans uncertain / evolving
- Traditional project has long lead time
- Hybrid capacity and reliability project
- Automated circuit reconfiguration with limited capacity

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Energy Storage– Reliability

- Parts of circuits needing reliability improvement requiring costly traditional project (long feeder project, new station / T line)
- Automated or manual backup ties available but capacity constrained in peak load periods
- Parts of circuits with critical loads (water/sewer, emergency operations centers, industrial customers with critical processes, etc.)

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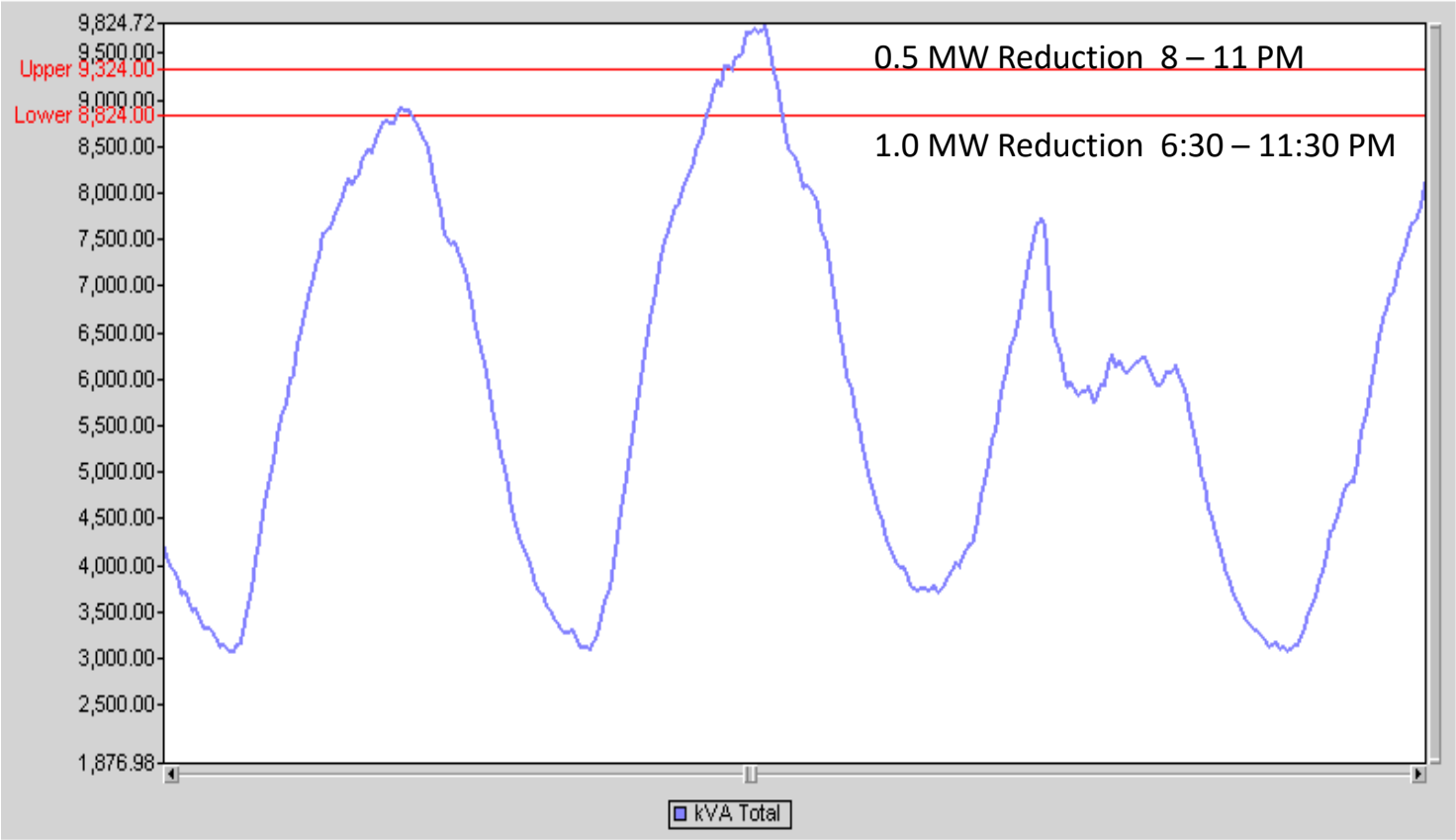
Example Feeder – Summer Peak Load



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Energy Storage Challenges

- Battery system costs
- Certainty of load forecast
- Additional benefit streams and ability to monetize
- Reliability / availability of Energy Storage

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Conclusion

- AEP is known as a leader in utilizing Energy Storage Technology
- AEP is evaluating multiple applications of Energy Storage and Microgrids to improve customer experience and lower costs.

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QUESTIONS ?

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