

Application of Large-Scale Energy Storage Systems in AEP

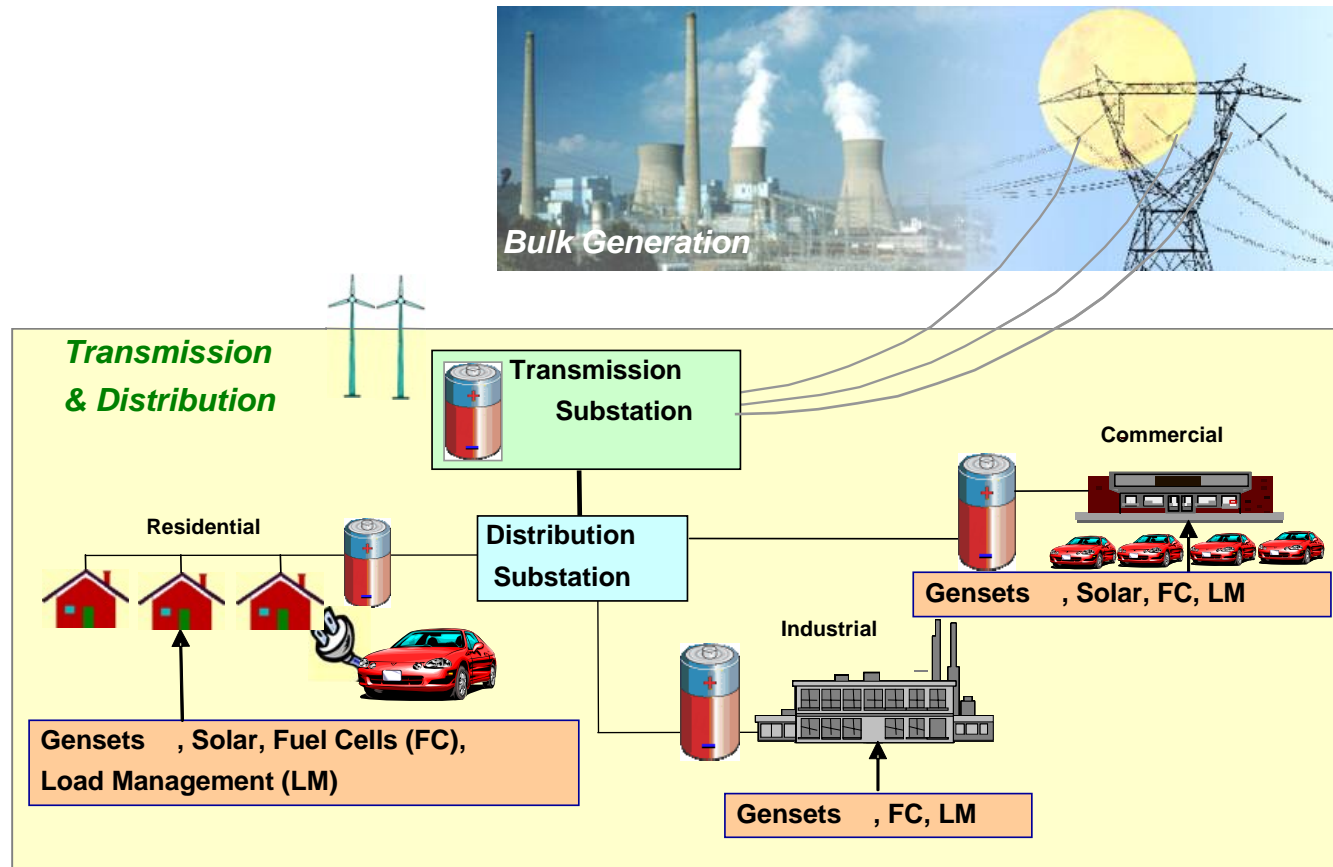


Ali Nourai
Distributed Energy Resources
American Electric Power

Funded in part by the Energy Storage Systems Program of the U.S. Department Of Energy (DOE/ESS) through Sandia National Laboratories (SNL).

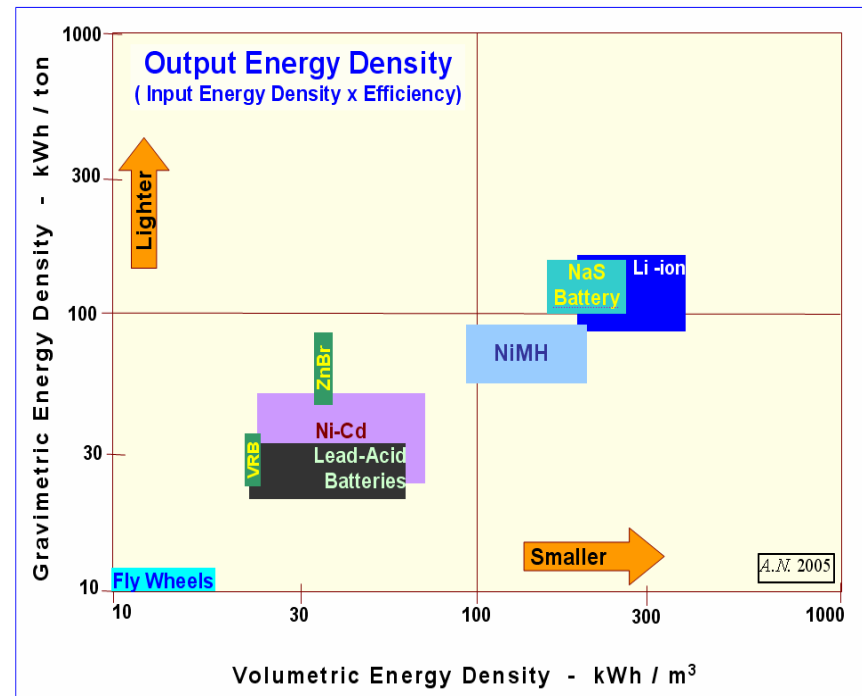
EESAT Conference
September 2007

A Possible Future of Distribution

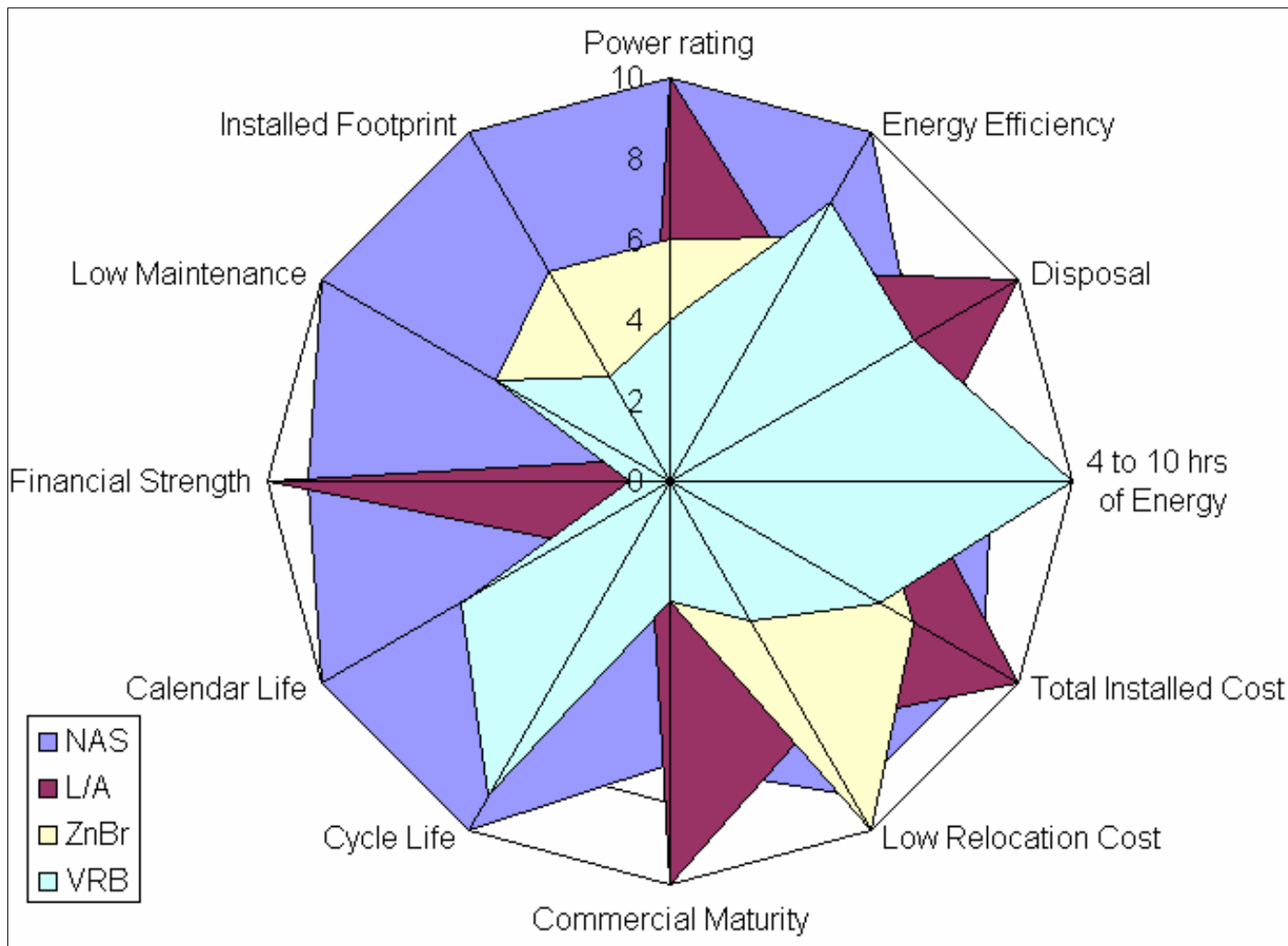


Storage Options for Utility Applications

- 1-10 MW, 4-8 hour storage systems
- After reviewing all feasible technologies, AEP selected Sodium Sulfur (NaS) battery for distributed energy storage
- NaS strengths:
 - ✓ *Cost*
 - ✓ *Favorable field experience*
 - ✓ *Compactness*
 - ✓ *Commercial record over 1MW*
 - ✓ *Modularity*
 - ✓ *Ability to be relocated*



Some Selection Criteria for Energy Storage



Partners



American Electric Power

- **Owner & Operator of DESS**
- **Project Management**
- **Site Work**
- **Permits**



NGK Insulators

- **Manufacturer of NAS Battery System**



S&C Electric Company

- **PCS**
- **System Integration**



DOE/Sandia

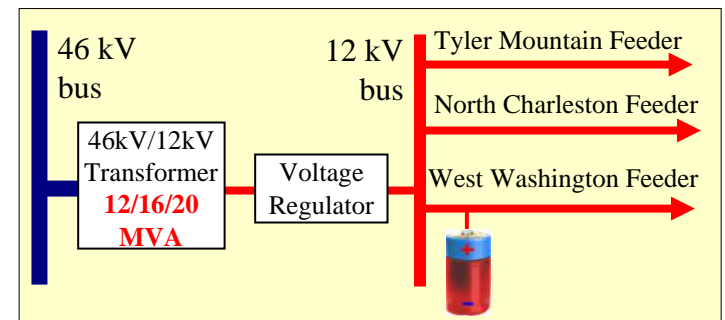
- **Partial Sponsor**

DOE/Sandia's *timely* support pushed AEP over the tipping point on its 1MW NAS project that is now grown into a commitment to deploy 1000 MW more energy storage over the next decade.

AEP's First Commercial Energy Storage System



- Charleston, WV
- 1.2 MW, 7.2 MWh
- Operational since June 26th 2006



Distributed Energy Storage System (DESS) Project

Main Function

1.2 MW Peak Shaving

Justifications

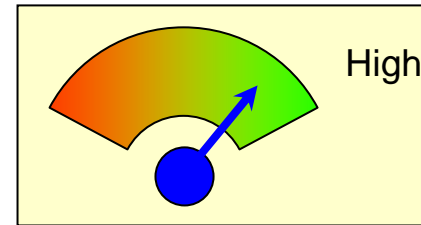
- 1) Corporate Strategy** (long-term economics)
- 2) Distribution Capital Deferral**
- 3) A Relatively Quick Solution**
- 4) Relocate-able to other Sites**
- 5) Market values (RTO)**

DOE Support

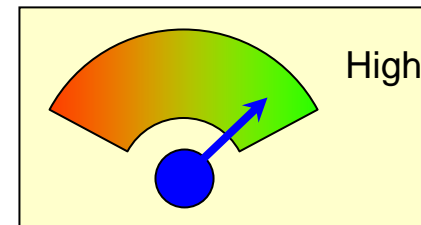
Covered Non-Repeat Expenses

LONG-TERM Economics of Energy Storage

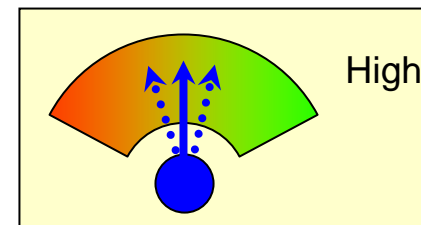
1. Strategic Values - *high*



2. Political Merits - *high*

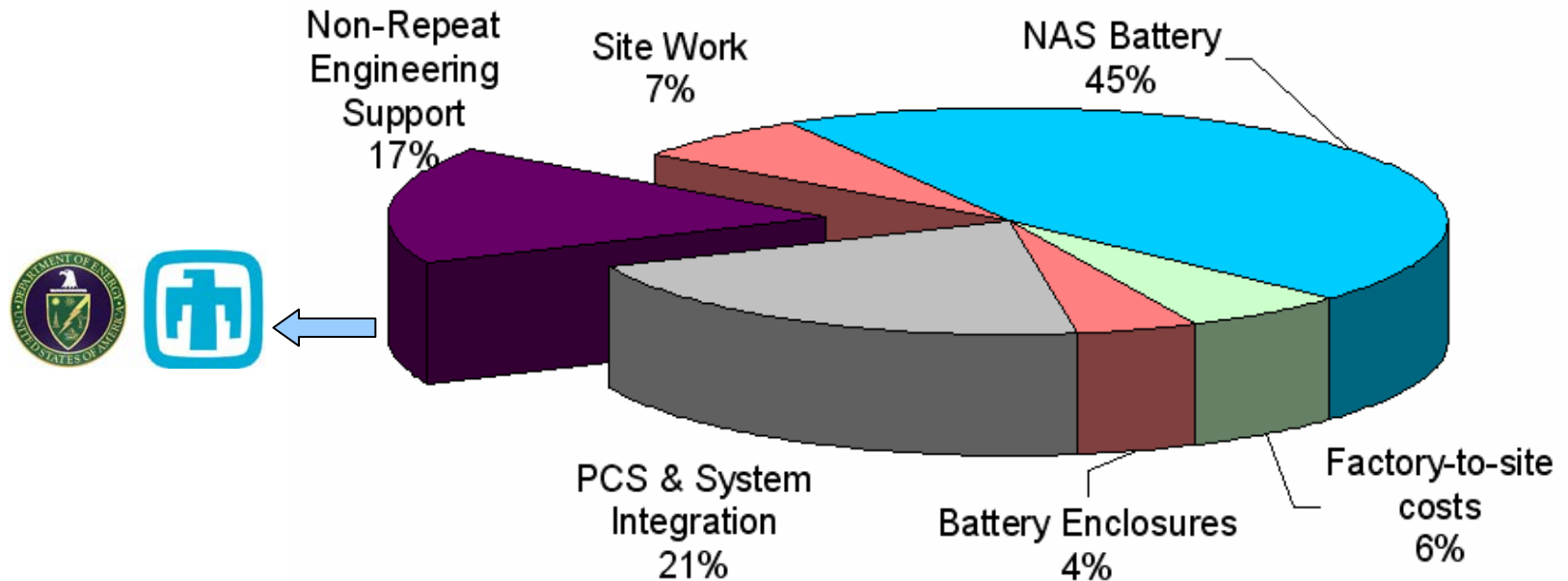


3. Short-term Cost/Benefit Analysis - *Marginal*



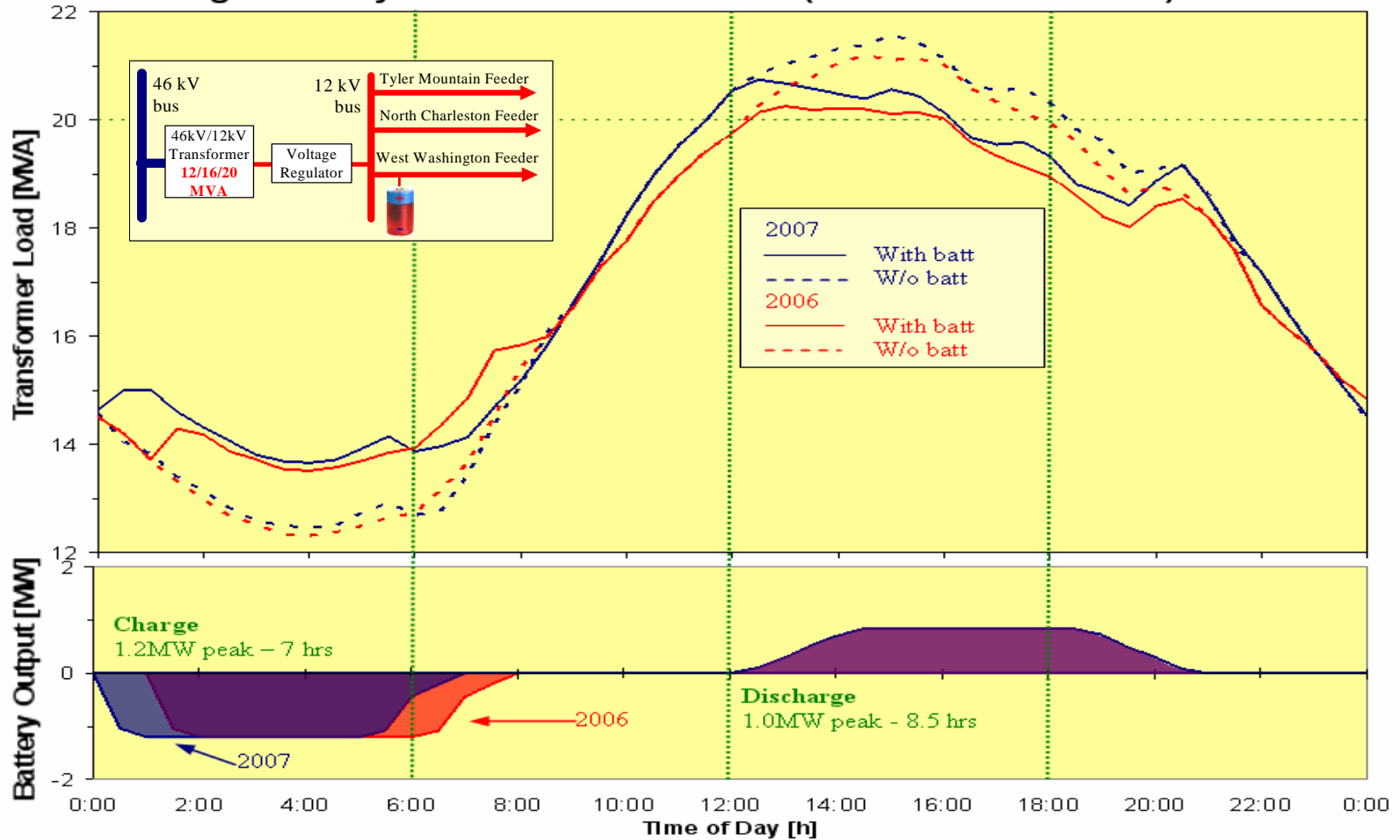
Storage Cost and DOE/Sandia's Role

Cost Components



Sample of Peak Shaving – Highest Peaks of each Year

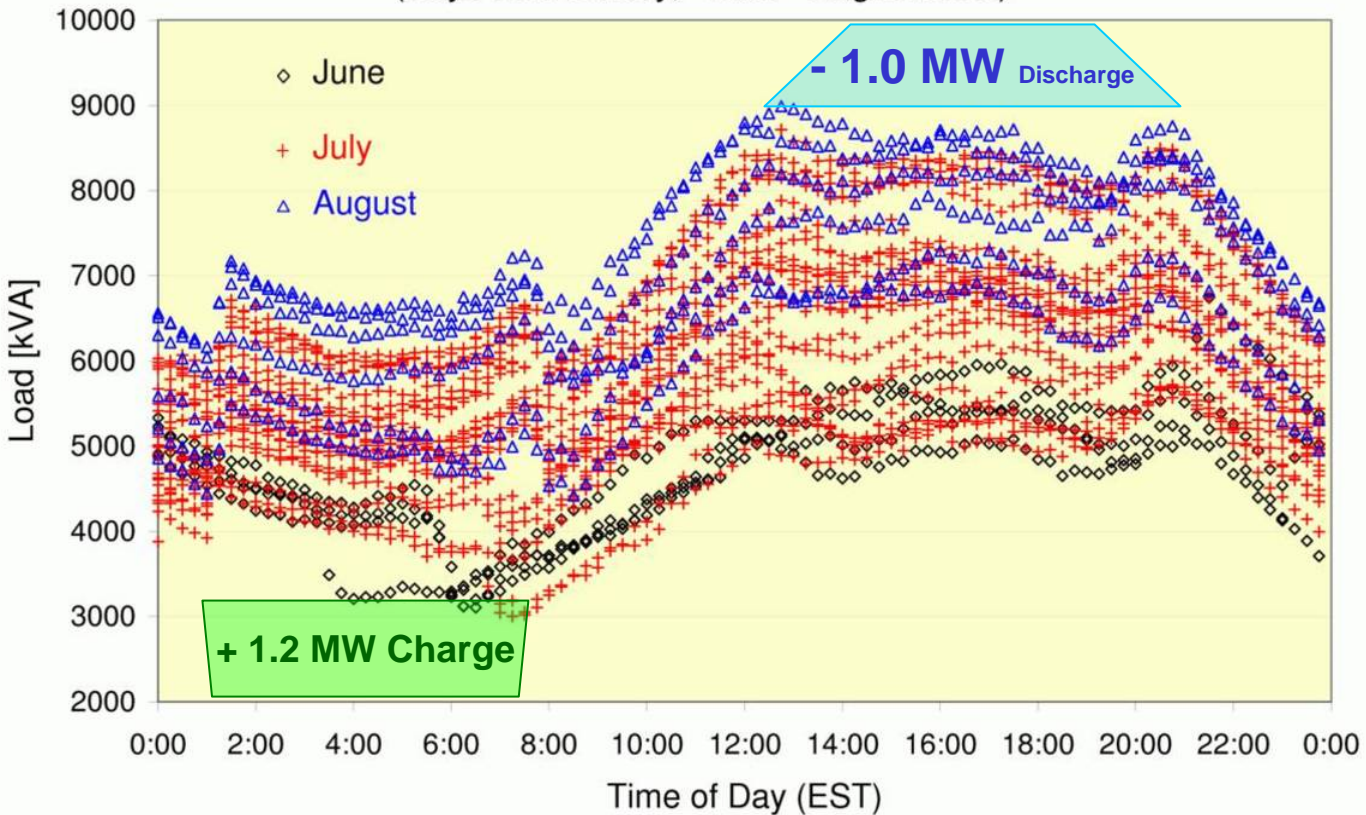
**Chemical Substation Transformer Load
Highest Daily Loads of 2006 and 2007 (8/3/2006 and 8/9/2007)**



Load Leveling - 2006

Chemical Substation: West Washington Load

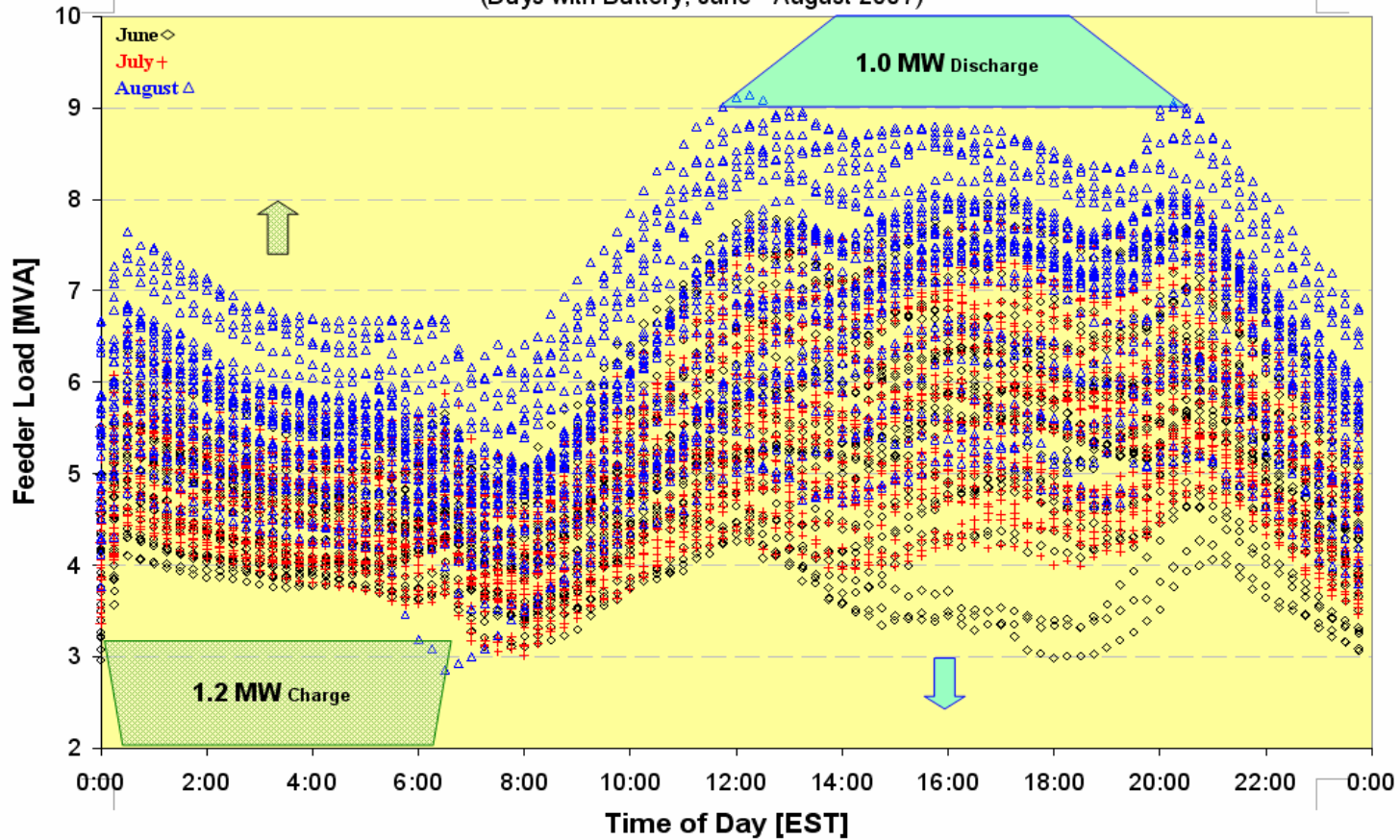
(Days With Battery, June - August 2006)



Load Factor Improved from an average of 0.75 to 0.80

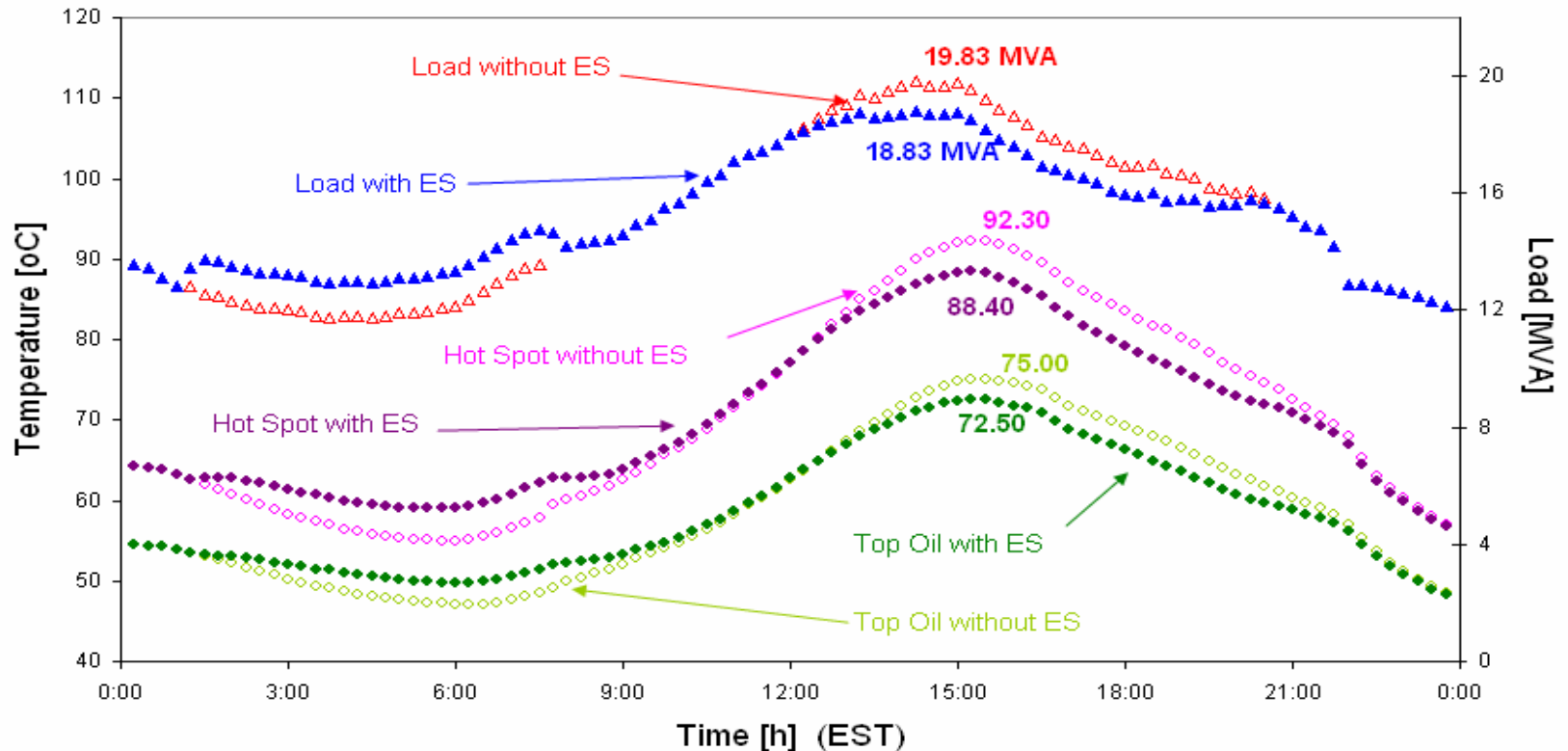
Load Leveling - 2007

Chemical Substation: West Washington Load
(Days with Battery, June - August 2007)



Impact on Transformer temperature

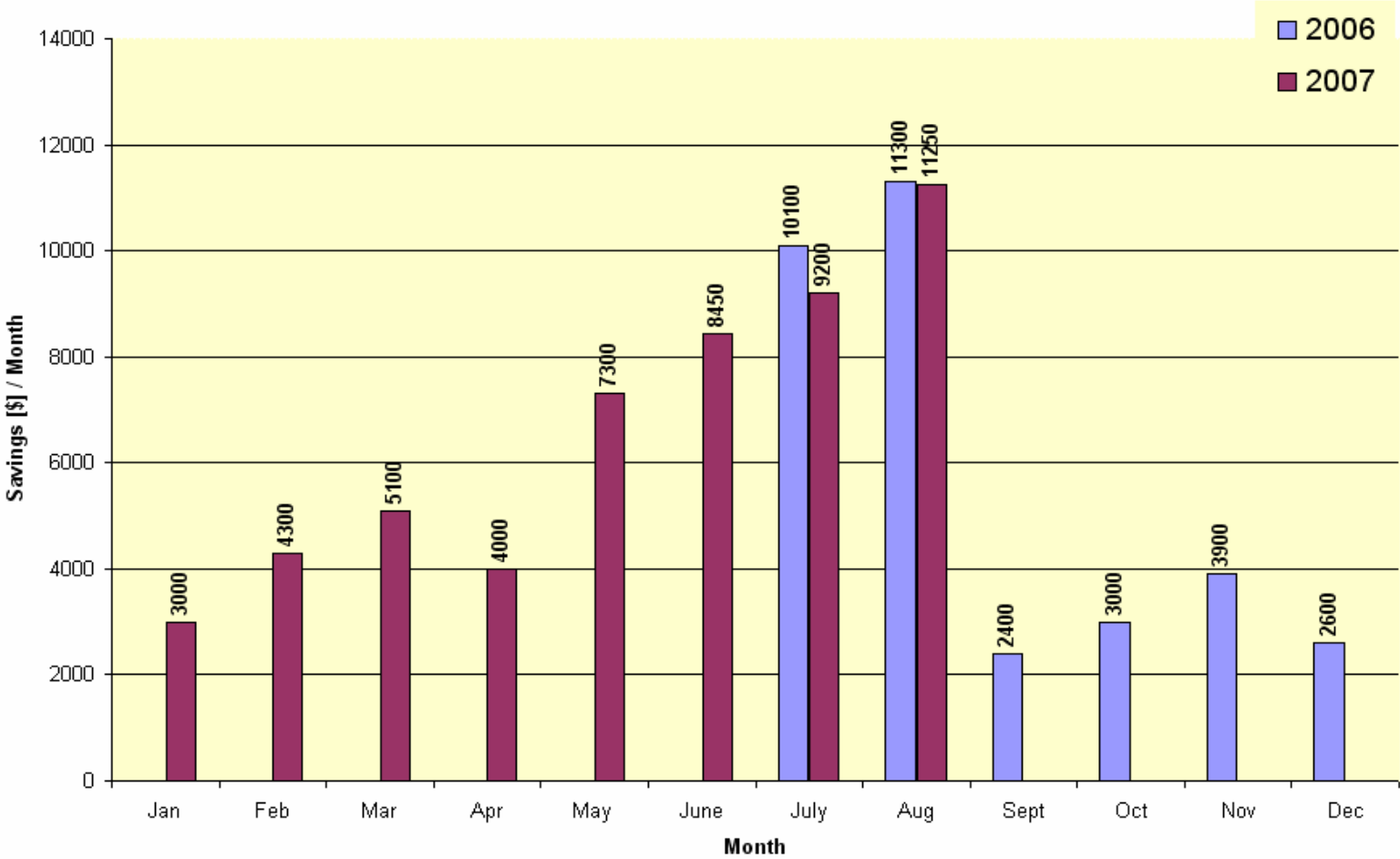
Transformer Load, Hot Spot and Top Oil Temperature
Chemical Substation - July 21, 2006



*Based on measured/calculated load and measured ambient temperature, Hot Spot and Top Oil temperature are calculated by using PTLoad 6.1, EPRI software.

Savings on the Energy Market (PJM)

Estimated Monthly Savings from AEP's 1 MW Energy Storage in Charleston, WV



Approximately \$5,500 per month



Performance Summary – 2006 & 2007

- 1MW NAS Battery Storage was installed and operational in just 9 months
- The battery helps shave transformer peak loads for 8.5 hours a day
- Keeps transformer temperature down by several degrees C
- Improves the feeder's Load Factor from 0.75 to 0.80, on average
- Provided a PJM Market Energy Value of \$5,500 per month (average)
- Helped AEP build more confidence on this Energy Storage initiative

SANDIA REPORT

SAND2007-3580
Unlimited Release
Printed June 2007

Installation of the First Distributed Energy Storage System (DESS) at American Electric Power (AEP)

A Study for the DOE Energy Storage Systems Program

Ali Nourai

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Sandia is a multiprogram laboratory operated by Sandia Corporation,
a Lockheed Martin Company, for the United States Department of Energy's
National Nuclear Security Administration under Contract DE-AC04-94AL85000.

Approved for public release; further dissemination unlimited.

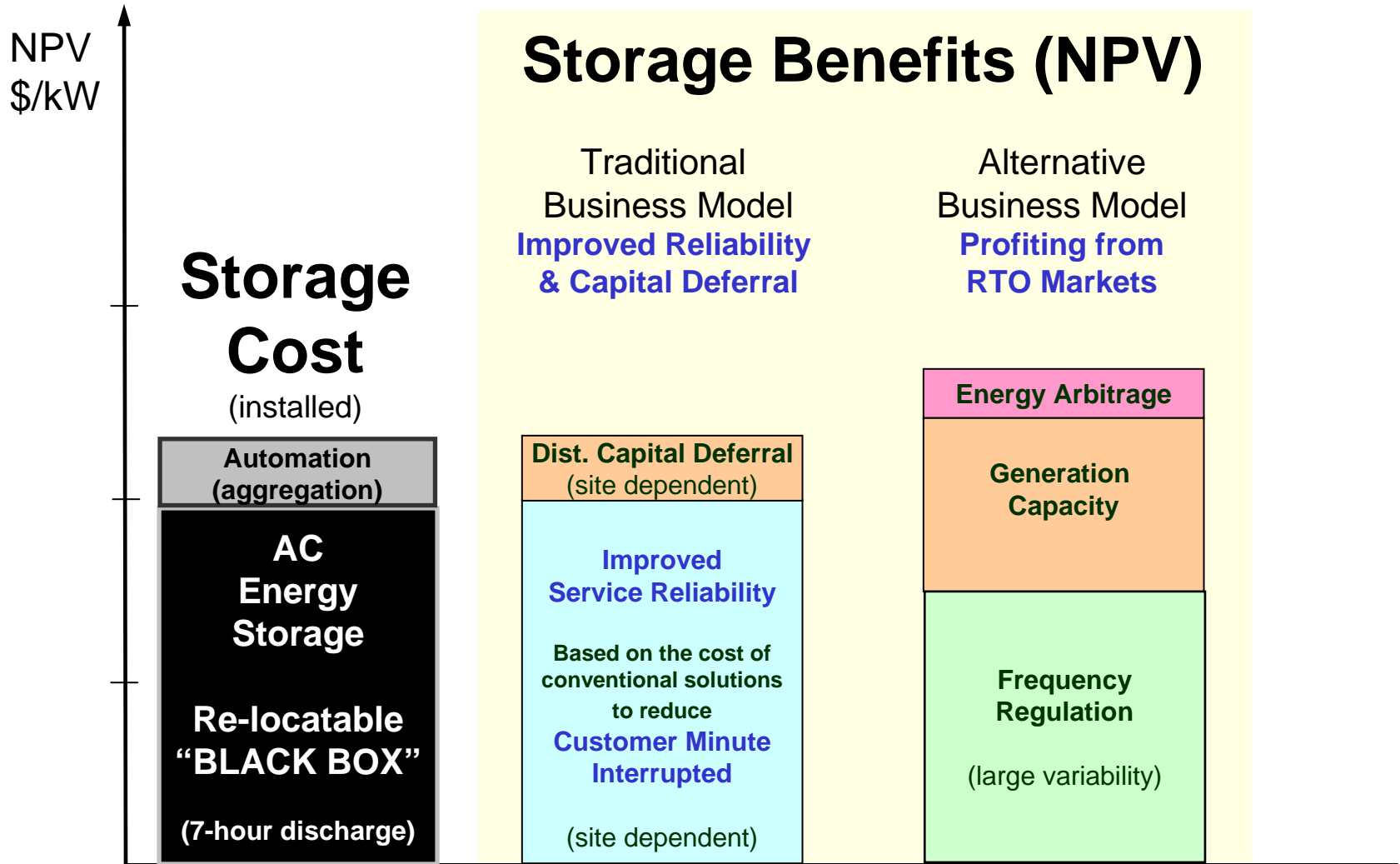
 Sandia National Laboratories

Free copies of the report
are available from the
Sandia website

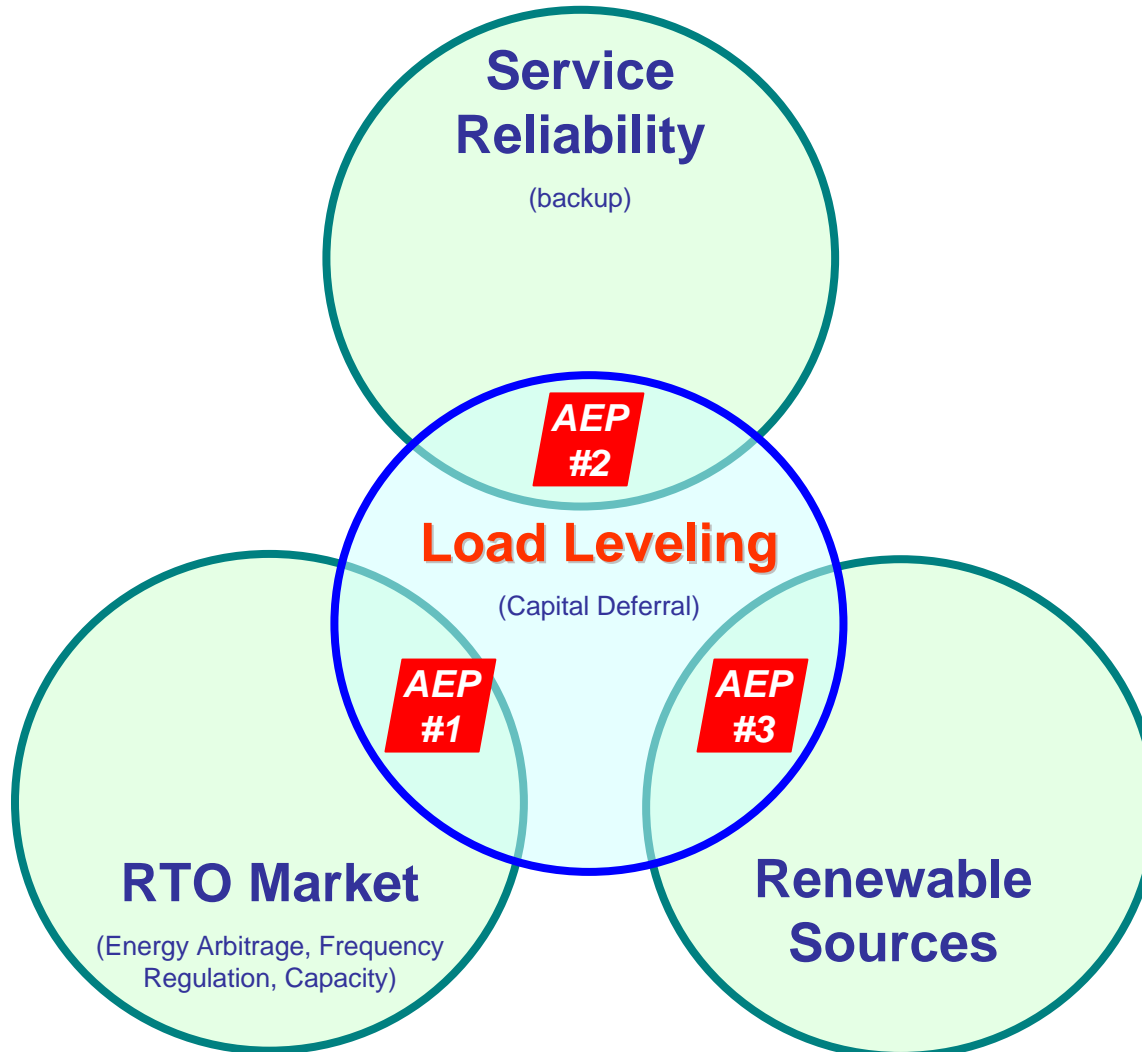
Going Forward

- Energy Storage has many utility benefits that, when combined, *MAY* pay for the equipment cost
- But all storage benefits may NOT apply to a given application
- **Need to choose the right application with the right business model**

Storage Benefits



Combining Storage Benefits



AEP News Release – September 2007

- Energy Storage is a key to the initiative for modernizing our grid
- 6 MW more NAS operational in 2008 (purchased)
- 25 MW more by the end of this decade
- 1000 MW more by the end of next decade