American Electric Power
Energy Storage

Presentation to:
IEEE / DOE / EAC
Energy Storage
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AEP System Overview

- 5.3 Million customers
- 11 States
- 39,000 MW Generation

AEP Service Territory

- 38,953 miles Transmission
- 212,781 miles Distribution
- 6006 Distribution Circuits
- 3240 D Transformer Windings
Energy Storage At AEP

- The Next Step -
AEP’s (NaS) Battery Application

1 MW, 7.2 MWh installed in Chemical Station (Charleston, WV - 2006)
- Deferred substation upgrades
Three installations in 2008 (2 MW Each)
- Peak Shaving
- Demonstrate “Islanding”
- Storage of intermittent renewables
- Sub-transmission support

AEP selected Sodium Sulfur (NaS) technology
- Proven technology in Japan (TEPCO)
- 1-10 MW, 4-8 hour storage systems
- NaS strengths:
  - Commercial record over 1MW (over 100 installations)
  - Cost
  - Compactness
  - Modularity & Ability to be relocated
Bluffton, OH – 2 MW with Islanding

NAS Battery Station

Two 1 MW NAS Units

PCS

Transformer

Genset
Load Leveling Example

Performance of Balls Gap's 2MW Battery from 12/17 to 12/19/2008
Churubusco, IN with Islanding

NaS Battery
The Concept of Community Energy Storage

- **CES** uses distributed resources to offer >> flexibility @ << cost than *bulk* storage as battery volumes increase
- CES fits with the Grid’s emerging need for **Distributed Intelligence AND Speed**
- Storage at the load offers unique benefits that bulk storage can’t match
  - Direct integration with PHEV batteries to act as a buffer for load mgmt (PHEV charging)
  - Direct integration with customer owned renewable resources
  - Demand Control thru contractual integration with HAN
Community Energy Storage (CES)

CES is a distributed fleet of small energy storage units connected to the secondary of transformers serving a few houses or small commercial loads.
### CES Specifications

#### Key Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
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<tbody>
<tr>
<td>Power (active and reactive)</td>
<td>25 kVA / 25 kW</td>
</tr>
<tr>
<td>Energy</td>
<td>25 kWh future 75 kWh</td>
</tr>
<tr>
<td>Voltage</td>
<td>240 / 120V AC</td>
</tr>
<tr>
<td>Battery – Similar to PHEV</td>
<td>Li-Ion</td>
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<tr>
<td>Round trip efficiency</td>
<td>&gt; 85%</td>
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AEP Specifications for CES are “OPEN SOURCE” for Public Use and Feedback. During 2009 EPRI hosted free, open webcasts to solicit industry wide input.

www.aeptechcenter.com/ces
Local Benefits:

1) Backup power
2) Flicker Mitigation
3) Renewable Integration
**CES – Virtual Station Scale Storage**

**Local Benefits:**
1) Backup power
2) Flicker Mitigation
3) Renewable Integration

**Grid Benefits:**
4) Load Leveling at substation
5) Power Factor Correction
6) Ancillary services

Communication & Control Layout for CES

![Diagram showing CES Control Hub, Substation, and Operations Center with Power Lines and Communication and Control Links]
CES Layout
Drivers for Energy Storage

- Peak Load Shaving / Leveling
  - T&D infrastructure project deferrals
  - Increased utilization of existing Generation
- Islanding of Load Area
- Smoothing Variability of Solar / Wind Generation
- Energy Arbitrage
  - Charge at lower cost / Discharge at higher value
- Ancillary Services
  - Frequency regulation
  - Spinning reserve
Balancing Cost and Benefits

• Energy Storage Cost is still high

• Energy density needs to improve

• Utilities need to find full value of energy storage
  – T&D deferral is easiest to calculate but varies greatly
  – Other values such as energy arbitrage, frequency, enhancement of variable energy sources, etc. do not have identified $$ values
DOE Project Enhancements

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Questions?

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