Modular Energy Storage Architecture (MESA)

PNUCC Board of Directors Meeting

June 7, 2013

Agenda

- Energy storage from utility’s perspective
  - Tremendous potential: integrate renewables, multiple use cases
  - Significant challenges: supply chain too costly, no standards
- Opportunity for software/IT expertise in Northwest
  - Transform the energy storage market through development of software/IT standards
  - Become industry center of gravity for energy storage
- Example: Snohomish PUD MESA project
  - Software by 1Energy Systems (Seattle) & Alstom (Redmond)
Challenge: Meet load growth and renewable portfolio standard requirements without the use of fossil fuels.

Wind Variability

Snohomish’s Aggregated Wind
No Diversity

**Grid Energy Storage**

- Storage potentially has many energy and power uses:
  - Variable energy resource integration
  - Peak shaving
  - Volt/VAR support
  - Infrastructure upgrade deferral
  - Frequency regulation

- Large scale hydro and pumped hydro storage facilities have dominated the storage landscape
  - Limited options geographically and environmentally

- Batteries are beginning to enable smaller and more modular/scalable energy storage systems
Current State

- Current battery-based grid energy storage offerings
  - Expensive
  - Lack modularity
  - Lack interoperability
  - Lack scalability
  - Lack standardization
  - Monolithic; vendors operate beyond core expertise

- Large gap between battery manufacturers and utilities
  - Core suppliers cannot easily serve core customers

Opportunity

- Implications:
  - Utility market for significant-scale battery based storage is very small and slow growing
  - Projects to-date are either highly optimized one-off niche projects, or small learning/demonstration projects
  - Decreasing battery prices alone are unlikely to stimulate utility energy storage market growth significantly
  - EPRI, battery manufactures, and others see the same landscape, but there is little apparent activity to facilitate change

- Opportunity: focus on architecture and standardization
  - Develop and deploy “Modular Energy Storage Architecture” (MESA)
Project Organization

MESA Project

Technology Transforming the Energy Storage Market
The Vision

- Energy storage = **flexibility**
  - Clean renewable power integration
  - Many grid management applications
- Significant growth projected
  - **94% of utilities**: energy storage very/somewhat important to smart grid development\(^1\)
  - **4x growth** in next 5 years ($3.5B to $18.5B)\(^2\)

---

\(^1\) Nov. 2012, IEEE Smart Grid, with analysis by Zprime
\(^2\) July 2011, BCC Research, *Utility-Scale Electricity Storage Technologies: Global Markets*

---

The Problem

- Supply chain challenges:
  - Expensive
  - Monolithic: limited interoperability
  - Proprietary: few standards, one-off projects

- Consequences of deficient standardization:
  - Suppliers (battery, PCS) can’t easily serve utilities
  - Vendors operating beyond core expertise (e.g. A123)
  - Unmanageable infrastructure for utilities
  - Growth limited, despite willing buyers and sellers
Comparison

<table>
<thead>
<tr>
<th>CES</th>
<th>Nissan Leaf</th>
</tr>
</thead>
<tbody>
<tr>
<td>• 25 kWh Li-ion battery</td>
<td>• 24 kWh Li-ion battery</td>
</tr>
<tr>
<td>• ~$100k</td>
<td>• $35k</td>
</tr>
<tr>
<td></td>
<td>• Plus a car</td>
</tr>
</tbody>
</table>

WA Opportunity – Jobs

• Batteries?
  – World’s major producers are in Korea, Japan, China
  – US-based bankruptcies:
    • A123 (batteries): $249 million US govt. investment
    • Ener1 (batteries): $199 million US govt. investment
    • Beacon Power (flywheel): $39 million US govt. investment

• Energy storage software/IT
  – WA state’s best asset: high-tech knowledge workers
  – Ideally suited to create infrastructure for energy storage and smart grid
MESA-1 Project

Partners
• Snohomish County PUD
• 1Energy Systems
• Alstom Grid
• Univ. of Washington
• Parker Hannifin (PCS, BOS)
• Battery partners

Outcomes
• 1 MW substation ESS
• Plug-and-play components
• Standards (IEEE, IEC)
• Shared learning
• Transform the market


Standards within the ESS

• Utilities want:
  – Standard components
  – Install, operate, maintain, upgrade, expand, ...
  – Functional, cost-effective supply chain

Analogy: PC Industry

ESS $\leftrightarrow$ {battery, PCS, ...}
**Standards from ESS to Utility I/T**

**Utilities want:**

- Standard interfaces between ESS and utility I/T (control, power supply, etc.)
- Interoperability
- Range of ESS sizes and sites (SES, CES, DES, etc.)

**Analogy: Internet Protocols**

---

**1Energy Systems**

**ESS Components**

- Energy (ESU)
- Power (PCU)
- Framework (container, etc.)
- EPC Services

**Software**

- Component mgmt (ESU, PCU)
- Modes: economic dispatch, r/e firming, peak shaving, load following, etc.
- Optimization
MESA: Transforming the Market

**MESA Goals**
- Transform energy storage market through **technology**
- Give utilities real **flexibility**
- Foster robust energy storage **market**

**MESA-WA Goals**
- Reach "**tipping point**" of battery/PCS companies supporting an open standard
- Multiple WA utilities deploying energy storage
- Actual projects to increase renewable integration
- Make WA the the **industry center of gravity** for energy storage