Demonstration of Modular Energy Storage in the Northwest

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Pacific Northwest National Laboratory

OE Energy Storage Systems Program Review

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Project objective: Analyze and demonstrate the benefits of electrical energy storage on the distribution grid

Situation

- Bainbridge Island, WA
- Murden Cove
- Winslow

Requirements

- 25MVa transformers at radial substations at Murden Cove and Winslow operate at or above target load
- Multiple hours of capacity required
- Small footprint to fit within a substation
- Year-round operation capabilities
- Flexibility to perform multiple applications (e.g., balancing svcs., islanding)

Novel technical solution

- EnergyPod®
  - 250 kW AC • 500 kWh
- Containerized, electrochemical energy storage with a 2nd generation flow battery technology
**Project schedule**

**Phase 1: Value assessment**

- Vet control strategy
- Make economic case
- Develop pilot plan

**Phase 2: Implementation**

- Build and commission
- Project development
- Test planning

**Phase 3: Monitor, revise value assessment & report**

- Operate and test
- Assess value creation
- Share lessons

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**Core tasks**

- SG 0.5: Sept ‘13
- SG 1.0: May ‘14
- SG 1.5: Sept ‘14
- SG 2.0: Sept ‘15

**Deliverable**

- Final Phase 1 report
- 3rd party test report
- “Go/ no-go”
- Permits
- Purchase Order
- Site plans & specifications
- Test plans
- Training materials & guides
- Test reports

- Indicates deliverable is complete
## Meaningful accomplishments to date

<table>
<thead>
<tr>
<th>Key elements</th>
<th>Milestones</th>
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<tbody>
<tr>
<td>✓ Positive economic case</td>
<td>✓ Sandia test</td>
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<tr>
<td>✓ Successful 3rd party test</td>
<td>✓ Sandia test</td>
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<tr>
<td>✓ Final report &amp; EESAT presentation</td>
<td>✓ Sandia test</td>
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### Stage gates 0.5 & 1.0

- Complete
- In progress

### Control strategy

- Positive economic case
- Successful 3rd party test
- Final report & EESAT presentation

### PSE internal buy-in

- Approval at C-level
- Budget approval
- Purchase Order

### Inter-connection

- System specifications
  - Complete
    - System impact study
    - Facilities study
- Application submission
  - Study completion

### Community outreach

- City Planning and permitting
- Support of Fire Department
  - City council support
- Local stakeholder engagement
- Planning meeting
  - FD and Fire council meetings
  - City council meeting
Positive economics and additional benefits

Present value of storage benefits/costs
$M, USD

- Capacity value
- Dist. upgrade deferral
- Outage mitigation
- Balancing svcs.
- Revenue requirement

Battery - Mid C capacity
- $22.8

Battery - Peaker capacity
- $28.6

Revenue requirement
- $20.5

- Regardless of capacity assumption economics “pencil out”
- Additional “difficult to quantify” value in
  - Knowledge transfer
  - Institutional know-how
  - Public awareness
Storage evaluation tool can be applied broadly
24-hour energy storage schedule for Bainbridge Island
Team has made marked progress toward completion of several near-term deliverables

<table>
<thead>
<tr>
<th>Category</th>
<th>Accomplishments for review criteria at SG2.0</th>
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<tbody>
<tr>
<td>Manufacturing</td>
<td>• Build of EnergyPod® 1 and PowerBox containers</td>
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<tr>
<td></td>
<td>• End-of-line test of EnergyCells</td>
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<td></td>
<td>• EnergyPod® operation and installation manual outline drafted</td>
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<tr>
<td>Interconnection</td>
<td>• System impact study complete</td>
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<tr>
<td></td>
<td>• Facilities study in progress</td>
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<tr>
<td>Siting and Civil</td>
<td>• Final site and civil designs</td>
</tr>
<tr>
<td></td>
<td>• Contractor(s) selected</td>
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<tr>
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<td>• Work on site scheduled or started</td>
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<tr>
<td>Testing</td>
<td>• Completed Factory, Site, Field testing plans</td>
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<td>• Site selected and test plan prepared for 3rd party off-site EnergyPod® 1 &amp; PowerBox test</td>
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<tr>
<td>Controls and Communication</td>
<td>• Demonstration of remote EnergyCell hardware control with Energy communications infrastructure</td>
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The first turnkey EnergyPod® container has arrived at Primus
Deliverables support holistic tech transfer

**Project team goal:** Enable reproducibility and continuous process of improvement in energy storage deployment through effective tech transfer

### Reports
- BPA
- DOE
- Other utilities
- Public

### Tools
- **PNNL storage evaluation tool**

### Manuals & “Playbooks”
- Primus / PSE
- As appropriate
  - BPA
  - DOE
  - Other utilities

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*transfer to …*
## Tasks completed / next steps

<table>
<thead>
<tr>
<th>Task or milestone</th>
<th>Owner(s)</th>
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<tbody>
<tr>
<td>Complete system impact study</td>
<td>PSE</td>
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<tr>
<td>Complete stakeholder outreach</td>
<td>PSE</td>
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<td>Complete test protocols drafts</td>
<td>PSE, PRIMUS POWER</td>
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<tr>
<td>Draft construction plans</td>
<td>PSE, PRIMUS POWER</td>
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<tr>
<td>Execute interconnection agreement</td>
<td>PSE</td>
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<tr>
<td>Select contractors; begin site preparation</td>
<td>PSE, PRIMUS POWER</td>
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<tr>
<td>Build and test EnergyPod® 1</td>
<td>PRIMUS POWER</td>
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<tr>
<td>Complete stage gate 2.0</td>
<td>PSE, PRIMUS POWER</td>
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<tr>
<td>Install EnergyPod® #1</td>
<td>PSE, PRIMUS POWER</td>
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<tr>
<td>Begin data acquisition and analysis</td>
<td>PSE, PRIMUS POWER</td>
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<tr>
<td>Install EnergyPod® #2</td>
<td>PSE, PRIMUS POWER</td>
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Acknowledgements

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- Mr. Dan Bornio, SNL