Energy Storage for Flexible and Local Capacity
Oregon Energy Storage Workshop
Portland, March 2014
Background: AES serves 11 million customers through utility and retail businesses and provides 38 GW of generation.

Key AES Corp Stats

- $18 billion in revenues
- $40 billion in assets
- 21 countries
- 38 GW generation
- 25,000 global workforce
- 11 million customers, 9 utilities

Fuel Type

- Coal: 37%
- Gas: 32%
- Renewables1: 25%
- Oil, Diesel & Pet Coke: 6%

1. Renewables includes: hydro, wind, biomass and landfill gas.
AES operates a 174 MW fleet of energy storage resources.
AES grid storage fleet has provided over 1.5 million MW-hours of commercial service.
64 MW Laurel Mountain battery resource operating commercially in PJM since 2011.

- Operating range of +32MW to -32MW
- Precise response to 4 second AGC
- Ramp rate mitigation
- Economic, daily bid in PJM power market
The Complete Alternative to Peaking Power Plants

Available to utilities and renewable developers.
www.aesenergystorage.com
Energy storage provides more flexibility and value than traditional peaking generation.

- **Gas Peaker**
  - 50 MW
  - Out of merit generation
  - Significant standby costs
  - Standby emissions

- **Storage Unit**
  - 50 MW
  - 0 direct emissions
  - Low standby costs

- **Flex range**
  - 40 MW for Gas Peaker
  - 100 MW for Storage Unit

- **Dispatch times**
  - Minutes to dispatch for Gas Peaker
  - Seconds to dispatch for Storage Unit
Needs: The U.S. has a 90 GW capacity need.

Electricity Capacity: Cumulative Unplanned Additions: Combustion Turbine/Diesel: Reference case

40GW in 15 years
Needs: The Northwest needs to plan for and procure capacity and flexibility.

“Looking forward, regional power planners will need to focus more on peaking capacity and system flexibility needs.”
Ideally, planning and procurement would include a feedback loop to improve subsequent cycles.

Participants:

- **Industry**
  - Utilities
  - Developers

- **Government**
  - Commission
  - Governor
  - Legislature

- **Stakeholders**
  - Customers
  - Environmental
  - Renewables

Criteria:

- Reliable
- Affordable
- Sustainable
The Northwest has a rich stakeholder environment that is supportive of storage.

**Industry**
- **Utilities**
  - PGE Salem Smart Power Center\(^1\)
  - PSE Bainbridge Island Storage Project\(^2\)
- **Developers**
  - NIPPC suggested batteries be considered in flexible capacity procurement.\(^3\)
  - Multiple developers proposed energy storage in PSE 2011 RFP.\(^4\)

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3. OPUC UM 1535: [http://edocs.puc.state.or.us/efdocs/HAC/um1535hac145757.pdf](http://edocs.puc.state.or.us/efdocs/HAC/um1535hac145757.pdf)
The Northwest has a rich stakeholder environment that is supportive of storage.

**Government**
- Commissions
  - Washington UTC requested utilities include energy storage in IRP.\(^1,2\)
- Governors
  - Oregon 10-Year Energy Action Plan recognizes potential for energy storage.\(^3\)
- Legislature
  - Washington legislature introduced bill requiring energy storage assessment in IRP.\(^4\)
- Congress
  - Senator Wyden introduced energy storage ITC bill.\(^5\)

**Industry**
- Utilities
- Developers

**Stakeholders**
- Customers
- Environmental
- Renewables

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\(^1\) WUTC UE-100961: http://www.wutc.wa.gov/rms2.nsf/177d98baa5918c7388256a550064a61e/112f993e187ec7b68825797400679954
\(^2\) WUTC UE-120767; http://www.wutc.wa.gov/rms2.nsf/177d98baa5918c7388256a550064a61e/4b0c052bf4e679fe88257c7700773244
\(^3\) http://www.oregon.gov/energy/Ten_Year/Ten_Year_Energy_Action_Plan_Final.pdf
The Northwest has a rich stakeholder environment that is supportive of storage.

**Other Stakeholders**

- **Customer Advocates**
  - CUB hosted energy storage panel at policy conference.

- **Renewables**
  - Renewable Northwest convened energy storage meetings.

- **Regional Coordination**
  - Northwest Power & Conservation Council highlighted storage as a flexibility option in the 6th Plan.
  - PNWER convened Energy Storage Council.

- **Other**
  - PNNL found that energy storage was less expensive than CTs for balancing.

**Industry**

- Utilities
- Developers

**Government**

- Commission
- Governor
- Legislature

**Stakeholders**

- Customers
- Environmental
- Renewables
Limited feedback inhibits progress toward storage as a mainstream capacity and flexibility resource option.

Participants:

- **Industry**
  - Utilities
  - Developers

- **Government**
  - Commission
  - Governor
  - Legislature

- **Stakeholders**
  - Customers
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  - Renewables

Criteria:

- Reliable
- Affordable
- Sustainable
Example: Utility 1 (Northwest)

IRP
- Identified resource need.
- Commission: “next IRP would be well served by a discussion of electric storage technologies”

RFP
- Received multiple battery bids totaling 250+ MW.

IRP
- Batteries were not modeled.
- Commission: “we find the level of evaluation to be insufficient”
### Example: Utility 2 (Northwest)

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| **IRP** | • Required to evaluate “all resource options” for flexible capacity.  
• Identified need for flexible peaking resources. |
| **RFP** | • Considered bids backed by battery technology.  
• Final IE report: “When all costs were considered, the [battery] Bid was economically highly competitive.”  
• Selected gas-fired peaking plant. |
| **IRP** | • Battery energy storage described as “neither technologically or economically viable.”  
• Assumed new gas-fired plant can not provide down ramp.  
• Identified future need for down ramp resources. |
Energy storage provides more flexibility and value than traditional peaking generation.

- **50 MW Gas Peaker**
  - out of merit generation
  - significant standby costs
  - standby emissions

- **50 MW Storage Unit**
  - 0 direct emissions
  - low standby costs

*minutes to dispatch* vs. *seconds to dispatch*
How can states and utilities incorporate energy storage into resource planning and procurement?

<table>
<thead>
<tr>
<th>Planning (IRP)</th>
<th>Procurement (RFP)</th>
</tr>
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<tbody>
<tr>
<td>Design</td>
<td>Design</td>
</tr>
<tr>
<td>Identify resource options</td>
<td>Solicit additional resources</td>
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</table>
Strong policy leadership helps.

Storage

Numerous storage options — including battery-based or pumped energy storage — can also increase the ability to balance out intermittent resources, such as wind or solar, and provide an alternative to building new infrastructure, such as transmission line expansion. As battery technology continues to become more efficient and the need to integrate more diverse generation resources increases, battery-based energy storage has the potential to offer a cost-competitive option.
How can states and utilities incorporate energy storage into resource planning and procurement?

**Planning (IRP)**
- Identify resource options
- Analyze optimal resource portfolio

Include storage as a resource option in Integrated Resource Planning.
- Utility
- Commission

**Procurement (RFP)**
- Solicit additional resources
- Evaluate offered resources

Hold procurement solicitations open to energy storage.
- Utility
- Stakeholders
- Commission or legislature
How can states and utilities incorporate energy storage into resource planning and procurement?

**Planning (IRP)**
- Design
- Modeling
- Identify resource options
- Analyze optimal resource portfolio

**Procurement (RFP)**
- Design
- Modeling
- Solicit additional resources
- Evaluate offered resources

✅ Comprehensively model the benefits of energy storage.
Capacity value and external (non-market) benefits contribute to storage cost-effectiveness.

“[P]roduction cost simulations capture only the operational value of a new storage device. The value of system capacity or resource adequacy needs to be calculated separately and combined with the operational value to produce a more complete value of a storage device.”

“[T]he net revenue of the storage plant in a market setting is … only about 50% of the reduction in operational costs produced when adding storage to the base system. The combination of incomplete capture of system benefits and price elasticity presents additional challenges to storage devices in restructured markets.”
Conventional technologies are not the least cost when studied on a life-cycle basis.

“This study revealed several insights into the technology ranking under life-cycle cost optimality.”

- The reference technology (CT) is not the least expensive option.
- Both batteries types were comparatively less expensive to the CT.
- The most costly cases were pumped-hydro and demand response alone.
Small amounts of storage can create large system-wide efficiencies in fuel use & emissions.

“All of the scenarios result in annual savings compared to the reference run.”

- Most of the savings are not from replacing diesel-fired generation with wind.
- The savings are achieved by the more efficient operation of conventional units.
  - Storage decreases the amount of spinning reserve and generation from single-cycle units which are often operated at their least efficient point.
  - Combined-cycle units are allowed to operate at higher, more efficient levels.
DOE can fund work that is actionable by states and utilities in policy, planning and procurement.

### Grid Energy Storage

**U.S. Department of Energy**

December 2013

<table>
<thead>
<tr>
<th>DOE Goal</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cost Competitive Energy Storage Technology</strong></td>
<td>Benefit/cost analysis of storage for grid resilience, emergency response, renewable deployment, and improved asset utilization</td>
</tr>
<tr>
<td><strong>Equitable Regulatory Environment</strong></td>
<td>Collaborative public-private sector characterization and evaluation of grid benefits of storage</td>
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<tr>
<td><strong>Industry Acceptance</strong></td>
<td>Adaptation of industry-accepted planning and operational tools to accommodate energy storage</td>
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<td>Conduct analyses and develop tools assessing the beneficial role of storage in cost-effectively achieving higher levels of renewable deployment</td>
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<td>Provide independent analytic support to public-private sector studies and field trials/demonstrations characterizing the benefits and costs of storage</td>
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<td></td>
<td>Collaborate with industry on enhancement of production cost models and other grid simulation/analysis tools to accurately incorporate storage</td>
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</tbody>
</table>
Thank you.

Praveen Kathpal
Vice President
AES Energy Storage
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Appendix

Resource Planning
Procurement
Resource Planning

Examples of energy storage in IRP:
✓ Hawaii
✓ Washington
The Hawaii Electric Companies modeled energy storage as a supply-side resource option in their 2013 IRP.

Supply-Side Resource Options

- Battery Energy Storage:
  - Spinning Reserve (25 MW: 30 minute discharge duration)
  - Frequency Regulation (25 MW: 15 minute discharge duration)
- Daily Peaking (10 MW: 90 minute discharge duration)

Hawaii PUC Docket #2012-0036
The Washington UTC requested that utilities include energy storage as a resource option in their next IRP.

“[T]he Company does not include any discussion of the various types of electric storage technologies in its Plan… But we believe that the Company’s next IRP would be well served by a discussion of electric storage technologies...“

Washington UTC Docket #UE-100961
Procurement

Examples of energy storage in procurement:
✓ Colorado
✓ Oregon
✓ California
Xcel/PSCo included energy storage as a resource option that can participate in a RFP for dispatchable resources.

<table>
<thead>
<tr>
<th>RFP Document</th>
<th>Resource Types</th>
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</thead>
</table>
| 2013 Dispatchable Resources RFP                  | • Simple cycle gas turbines  
• Combined cycle gas turbines  
• Stand-alone storage projects |
| 2013 Semi-Dispatchable Renewable Capacity Resources RFP | • Solar thermal with thermal storage or fuel back-up  
• Any other intermittent resource with storage or fuel backup |
| 2013 Renewable Resources RFP                     | • Wind  
• Solar without storage or fuel backup  
• Hydroelectric  
• Geothermal  
• Biomass  
• Recycled Energy |
Portland General included energy storage as a RFP resource option in response to stakeholder comment.

“PGE’s RFP should allow for broader use of technologies and alternatives that might meet its needs.

…

“NIPPC also suggests that PGE consider flexible capacity bids backed by grid-scale battery-based energy storage.”

“PGE will consider bids backed by battery technology.”

OREGON PUC DOCKET #UM 1535
The California PUC is implementing a statutory requirement to consider energy storage procurement targets.

SCE shall procure between 1400 and 1800 MW of capacity to meet local capacity requirements by 2021.

…”At least 50 MW of capacity must be procured from energy storage resources.”

California PUC Rulemaking #12-03-014

- Initial Proposed Energy Storage Procurement Targets (in MW)

<table>
<thead>
<tr>
<th>Case category, by utility</th>
<th>2014</th>
<th>2016</th>
<th>2018</th>
<th>2020</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 - all 3 utilities</td>
<td>200</td>
<td>270</td>
<td>365</td>
<td>490</td>
<td>1,325</td>
</tr>
</tbody>
</table>

California PUC Rulemaking #10-12-007