Pacific Northwest Demand Response Project

Lee Hall, BPA Smart Grid Program Manager

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• Installed wind capacity is approaching 50 percent of our load
• Not much geographic diversity; most in BPA’s balancing authority
• Nearing limits of hydro system to provide balancing reserves
Wind increasing -- more than 4,000 MW
Regional situational analysis – issues to address

1) Operational reserve and capacity constraints

- **Wind integration**: BPA faces significant balancing reserve demands
- **River management**: BPA is at the limits of balancing reserves but must ensure sufficient margin to meet multiple use requirements, including managing over-generation events
- **Ease supply constraints** and operational demands during summer and winter peaks and large unit outages

2) Transmission expansion challenges

3) Economic impacts on utilities

- Rate design with demand charge creates incentives for our customer utilities to invest in DR
Nationally – Demand Response is used extensively. Programs across US total at least 58,000MW\(^1\)

- Available DR is an average of about 5 – 10% of peak in other regions
- Much of the DR in the nation is for capacity (peak management)
- In the PNW, Pacificorp and Idaho Power have had 300MW+ programs
- Cost is $4 - $7 kW/month for mature programs
- 3\(^{rd}\) Party aggregators have played a major role.

\(^1\)Source: FERC Demand Response & Advanced Metering Report, February 2011
Over the past four years in the Northwest, BPA and Utilities have partnered in a series of pilots and demonstrations

- **Invested in research**
  - Together, BPA Technology Innovation, BPA Demand Response, and our utility and consultant partners have spent ~$4.5 million on DR research from FY 2009 through FY 2012

- **Finishing four years of field testing, pilots, modeling, and analysis**

- **Sixteen utilities and BPA have partnered on DR pilots**

- Additionally, at least 44 utilities have, or plan to, implement AMI...a potential enabler for DR
### PNW DR pilots sponsored by BPA: technologies tested for residential, C & I, and irrigation applications

<table>
<thead>
<tr>
<th>Utility</th>
<th>Sector/Expected MW</th>
<th>Technology/Planned Installs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Residential</td>
<td>Commercial</td>
</tr>
<tr>
<td></td>
<td>Irrigation</td>
<td>Industrial</td>
</tr>
<tr>
<td></td>
<td>Building management</td>
<td>Storage-batteries</td>
</tr>
<tr>
<td></td>
<td>HVAC thermostat</td>
<td>In-home displays</td>
</tr>
<tr>
<td></td>
<td>Process adjustment</td>
<td>Refrigeration/cold storage</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Thermal storage space heating</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Thermal storage water heating</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Water heater controller</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Water pumping</td>
</tr>
<tr>
<td>Central Electric</td>
<td>0.2</td>
<td>403</td>
</tr>
<tr>
<td>City of Forest Grove</td>
<td>0.4</td>
<td>0.1</td>
</tr>
<tr>
<td></td>
<td>1.8</td>
<td>1  1  2  4  4  2</td>
</tr>
<tr>
<td>City of Port Angeles</td>
<td>0.4</td>
<td>0.2</td>
</tr>
<tr>
<td>City of Richland</td>
<td>0.1</td>
<td>0.2</td>
</tr>
<tr>
<td>Clark Public Utilities</td>
<td>0.1</td>
<td>Columbia Rural Electric Association 1</td>
</tr>
<tr>
<td>Columbia REA</td>
<td>3.0-5.0</td>
<td>1</td>
</tr>
<tr>
<td>Consumers Power</td>
<td>0.1 - 0.2</td>
<td>0.3</td>
</tr>
<tr>
<td>Cowlitz County PUD</td>
<td>0.1 - 0.2</td>
<td>70  10  10  200</td>
</tr>
<tr>
<td>Emerald PUD</td>
<td>0.3</td>
<td>200</td>
</tr>
<tr>
<td>EWWEB</td>
<td>0.1</td>
<td>100</td>
</tr>
<tr>
<td>Kootenai Electric</td>
<td>0.1-0.2</td>
<td>1  78  95  6  2</td>
</tr>
<tr>
<td>Lower Valley</td>
<td>0.1-0.2</td>
<td>3</td>
</tr>
<tr>
<td>Mason County PUD #3</td>
<td>0.1-0.2</td>
<td>200</td>
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<tr>
<td>Orcas Power &amp; Light</td>
<td>0.4</td>
<td>410</td>
</tr>
<tr>
<td>United Electric Co-op</td>
<td>1.8</td>
<td>4</td>
</tr>
</tbody>
</table>
OpenADR DR platform tested: We have a means to dispatch and measure Events – Now how do we develop a resource for use by both utilities and BPA?

We’ve tested the Grid OpenADR compliant platform to trigger events in several pilots:

- Used OpenADR, a standard protocol for DR
- Dispatch platform that can be used to coordinate multiple needs – by the utility for peak management (day ahead) and by BPA for balancing (10 minute notification)
We have piloted a DR Business Case Tool for Utilities to evaluate DR investments (in thermal storage)

Unique cost/benefit for each utility based on potential revenue streams:

- peak reduction
- load shaping
- balancing service

Leave behind Excel Tool. Review sessions with PNGC, Flathead Electric, and others

<table>
<thead>
<tr>
<th>Financial results per device (incl. costs for comm. &amp; data kit)</th>
<th>Additional investment</th>
<th>Add. annual maintenance</th>
<th>Annual revenue</th>
<th>Payback time [years]</th>
<th>Annual return %</th>
<th>Costs</th>
<th>benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steffes IWHC with 50 gallon tank</td>
<td>$1,058</td>
<td>$11</td>
<td>$231</td>
<td>4.8</td>
<td>20%</td>
<td>$-1,270</td>
<td>$4,611</td>
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<tr>
<td>Steffes IWHC with 105 gallon tank</td>
<td>$1,705</td>
<td>$17</td>
<td>$270</td>
<td>6.2</td>
<td>14%</td>
<td>$-2,046</td>
<td>$5,404</td>
</tr>
<tr>
<td>Steffes ETS furnace (Forced air) (Incl. Air source Heat Pump)</td>
<td>$4,382</td>
<td>$74</td>
<td>$751</td>
<td>14%</td>
<td>8%</td>
<td>$-5,858</td>
<td>$14,564</td>
</tr>
<tr>
<td>Steffes ETS furnace (Hydronic) (Incl. Air source Heat Pump)</td>
<td>$6,671</td>
<td>$95</td>
<td>$951</td>
<td>9.5</td>
<td>8%</td>
<td>$-6,605</td>
<td>$15,910</td>
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<tr>
<td>Carina WISE controller 50 gallon retrofit</td>
<td>$630</td>
<td>$10</td>
<td>$208</td>
<td>3.1</td>
<td>32%</td>
<td>$-756</td>
<td>$4,160</td>
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<tr>
<td>One-Way WH Controller Switch</td>
<td>$300</td>
<td>$3</td>
<td>$90</td>
<td>3.5</td>
<td>29%</td>
<td>$-360</td>
<td>$1,795</td>
</tr>
</tbody>
</table>
Moving forward with a **two-pronged approach** – TI program and DR commercial demonstration projects

**TI Program:**

- Proof of concept research and development projects as part of BPA’s *Technology Innovation* program
  - Evaluate DR potential of new technologies and loads of significant interest to the region
  - Eight new DR-related projects selected for FY2013 TI portfolio, focused on:
    - data centers – *the only test of its kind in the nation*
    - heat pump water heaters
    - municipal wastewater treatment
    - energy storage
  - Developing focus for next year’s TI portfolio
Moving forward with a two-pronged approach – TI program and DR business plan

TI Program (continued):

• Developing focus for next year’s TI portfolio to test these technologies:

  • Lighting – specifically LEDs
  • Battery storage
  • Next generation of thermal storage (e.g., new types of water heater controls and space heating devices)
  • Whole home energy automation, including the use of home area networks including the use of smart thermostats, smart appliances, et cetera.
  • Heat pump water heaters and DR/EE
  • Small renewables and utility scale integration
  • Distributed generation resources
  • Communication systems and protocols, such as OpenADR
  • Aquifer recharge and other new load opportunities
  • Understanding DR potential of commercial building, irrigation and industrial energy control systems.
Moving forward with a two-pronged approach – TI program and DR business plan

DR Commercial Demonstration Projects:

- Identify *potential larger-scale commercial demonstration* projects designed to prove the availability and reliability of DR to help address multiple regional needs
  - Work with utilities, DR aggregators, and other groups throughout the region to identify, design, implement, and test new DR projects
  - Moving far beyond peak load management to address multiple purposes and objectives
  - Use proven technologies from DR pilots, including end-use technologies and DR management system
  - Leverage strong working relationships with utilities and other stakeholders
Moving forward with a two-pronged approach – TI program and DR business plan

DR Commercial Demonstration Projects (continued):

- Focus on areas with most likely near-term needs
  - Transmission congestion, power system peaks, balancing reserves and oversupply

- Objectives:
  - Determine best commercial arrangements, acquisition method, and equitable cost allocation
  - Evaluate dispatch by BPA and/or utilities
  - Achieve an operationally meaningful scale
Moving forward: A commercial demonstration phase, and continuation of collaboration

- **Joint Approach.** Work with utilities and regional groups to identify, design, and implement projects

- **Mix of Partners.** Select a mix of partners, including utilities (load following and slice, within and outside of BA) and at least one DR aggregator, utilities as aggregators – other ideas?

- **Cost Allocation.** The cost allocation for each project will be determined by an analysis of expected benefits, with each participating utility contributing based on the expected benefit they would receive

- **Scale.** Portfolio should be as simple as possible while still being commercially viable and operationally meaningful
  - Collaboration throughout agency to operationalize DR with a meaningful scale
  - Ideally 4-6 projects (excluding Technology Innovation and non-wires projects)
    - To test multiple DR products/uses, acquisition methods, geographies and load types with manageable cost and operations impact
    - $3.2 Million allocated in FY14 and FY15
  - Contract length: up to three years

**Proof-of-Concept Pilots (Technical Feasibility)**

**Continued TI (R & D) Pilots of New Technology**

**Commercial Demonstrations**

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**Continue with the Two-pronged approach:**
TI Program and Commercial Demonstrations
We have identified four potential DR “products”

<table>
<thead>
<tr>
<th>DR Product</th>
<th>BPA Benefits</th>
<th>Utility Benefits</th>
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</table>
| Capacity                    | • Lower cost power capacity  
                              • Economic opportunities                                                            | • LF: Lower wholesale power costs  
                              • Slice: Power capacity and economic opportunities                                  |
| Balancing Reserves          | • Increased and lower cost INC and DEC reserve capacity  
                              • Increased VERBS revenue                                                           | • Slice: Increased INC and DEC reserve capacity  
                              • Reduced BPA costs over time                                                       |
| Generation Oversupply       | • Decreased costs  
                              • Less need to curtail wind                                                           | • Productive use for oversupply energy  
                              • Reduced BPA costs over time                                                       |
| ‘Non-wires’ Peak Load Reduction | • Capital cost savings from deferring or reducing Transmission construction | • Capital cost savings from deferring or reducing distribution investments        |

INC = within-hour load increase  
DEC = within-hour load decrease  
LF = Load Following  
VERBS = Variable Energy Resource Balancing Service
Several approaches envisioned for participation -- Bring BPA your ideas!

- **Single Utility Model**
  - Utility designs and implements a DR commercial demonstration project in its own service area
    - Could be implemented by utility itself or a third-party

- **Group of Utilities Model**
  - Group of utilities work together to design and implement a DR commercial demonstration project across their service areas
    - Could be implemented by utility itself or a third-party

- **Utilities with DR Aggregator**
  - Join a BPA-coordinated team of utilities to evaluate and select a DR aggregator to implement a DR commercial demonstration project across service areas of participating utilities
Outreach and engagement approach

Group Meetings
- All-utility meeting on 2/7
- Utility group follow-up meetings (ICUA, NWPPA, PPC)
- Continue discussions with PNGC, NRU, etc.

Interested Utility Meetings
- Meet individually with interested utilities to design DR projects
- Assess benefits and cost allocation
- Joint utility/BPA aggregator evaluation

Proposed DR Project Portfolio
- # MWs available
- Utility partners
- Aggregator role
- Expected benefit
- Acquisition method
- Budget
- Funding plan
- Operations plan
- Dispatch strategy
- Systems approach
- Governance plan
- Evaluation plan
- Implementation roadmap

Implementation of DR Commercial Demonstration Project Portfolio

3/31/2013
- Interested Utility Meetings
- Meet individually with interested utilities to design DR projects
- Assess benefits and cost allocation
- Joint utility/BPA aggregator evaluation

7/31/2013
- Proposed DR project portfolio
- Budget and funding plan
- Acquisition method

9/30/2013
- Identify mutually-beneficial, cost-effective DR projects
- Cost/benefit analysis
- Cost allocation approach

Through 9/2015
- Additional education for interested utilities and utility groups
- Partner utilities for next step identified
- Implementation roadmap
Contact Information

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