BPA Distributed Energy Resources Overview

PNWER Summit
July 2017
BPA Profile

- BPA is a federal power marketing administration headquartered in Portland.
- BPA is part of the U.S. Department of Energy, but it is self-funded and covers all of its costs by selling products and services.
- Congress created BPA in 1937 to sell power at cost-based rates to publicly owned utilities and build the electric transmission system to deliver that power.
- BPA markets the largest supply of low cost, clean, carbon free energy in the nation.
- BPA operates and maintains the largest electric transmission system in the Pacific Northwest.
BPA Quick Facts

- 300,000 sq mile service area
- 142 public power customers
- 490 transmission customers
- 15,000 miles of high voltage transmission lines
- 31 federal dams
  - 21 US Army Corps of Engineers
  - 10 Bureau of Reclamation
- Hydro generation: 8,491 aMW
- Several large IOUs also operate in the region.

BPA Transmission System and Federal Dams
BPA Resources are Predominantly Hydro Generation in the Federal Columbia River System (FCRPS); This has been a source of low cost power for the PNW for decades.
Distributed Energy Resources at BPA

**Demand Response**
- changes in electric usage by end-use customers from their normal consumption patterns in response to changes in the price of electricity over time or to incentive payments

**Distributed Generation**
- small generation systems located at a customer site

**Energy Storage**
- technologies that allow electricity generated at one time to be used at another time
Drivers for DER at BPA

• **Transmission Opportunities & Cost of Wires Projects**
  - A non-wires measure to assist in the deferral or avoidance of a transmission build.
  - A bridge between the electrification of a new line and the need date.

• **Multi-use for Power Operations**
  - A tool to provide more flexibility in managing the FCRPS, address peaks, and help fill real-time deficits.

• **Integrating Renewables**
  - Installed wind capacity is significant, and new challenge with solar. (Currently not a strong need; however, DR has been tested and shown to be an effective tool to supplement the FCRPS in providing balancing reserves)

• **Customer utility interest**
  - Reducing demand charge (load following) and as a tool to help manage their distribution system.

• **7th Power Plan (NW Power and Conservation Council)**

---

The hydro system has been stretched to its physical margin,” Mainzer said. “Our task is to bring new and cost-effective, flexible capacity from outside of the hydro system.”

Keynote speech, national conference (Oct 2013)
Extensive DER Piloting and Testing in the Region (2009-2016) – A Partial List

FAQ

• Pilots with > 20 utilities
• Tests in residential, public, commercial, industrial, and agriculture sectors.
• Technologies included 10 asset types, e.g. 1000+ water heater controllers, HVAC controls, water pumping, thermal storage and building mgt. systems.
• Tests included not only peak shaving but innovative “DR 2.0” testing of new uses:
  • Load up (DECs)
  • Balancing Service
  • Load Shifting
• Many of these utilities have turned out to be first movers in DR demonstrations.
In 2014 BPA Moved to Larger and More Complex Advanced Demonstrations of DER

<table>
<thead>
<tr>
<th>Entity</th>
<th>Status</th>
<th>MW</th>
<th>Timing</th>
<th>Product Demonstrated</th>
</tr>
</thead>
<tbody>
<tr>
<td>City of Port Angeles</td>
<td>Complete</td>
<td>30</td>
<td>2013 - 2014</td>
<td>✓ Imbalance Capacity</td>
</tr>
<tr>
<td>Energy Northwest</td>
<td>Complete</td>
<td>35</td>
<td>2014 – Jan 2016</td>
<td>✓ Imbalance Capacity</td>
</tr>
</tbody>
</table>
| EnerNOC                 | Complete (Report in Progress) | 17  | 2015 - 2017     | ✓ Winter Peak Shave  
|                         |                         |     |                 | ✓ Summer Congestion Relief |
| Energy Northwest        | Started June 1st        | Up to 50 | 2017     | ✓ Summer Peak       |
| Total Portfolio         |                         | Up to 130 MW |         |                      |
DER Program and Technologies Continue to Evolve

Goal: BPA with Commercial Ready Products

- DER Program and Technologies Continue to Evolve

Pilots ➔ Commercial Demonstrations ➔ Commercial Operations

- Identify
- Test & Evaluate
- Documented Readiness

- Reliable
- Tested by Operations at Scale
- Model Contracts in Place
- Growing Supply Base

Transition to Implementation Orgs
Loads that are Traditionally Suitable for Demand Response

**Residential**

- Electric Water Heaters (0.4 - 0.7 kW)
- Air Conditioning (1 – 1.5 kW)
- Electric Space Heating (1.5 – 2.5 kW)

**Commercial & Industrial**

- Lighting, HVAC, Equipment, Generation
- HVAC, Lighting, Equipment, Non-Critical areas
- HVAC, Lighting, Office, Employee HVAC
- HVAC, Lighting, Generation
- HVAC, Lighting, Generation
- HVAC, Lighting, Generation
- HVAC, Lighting, Generation, Non-Critical areas
- HVAC, Lighting, Generation
- HVAC, Lighting, Generation

- **Municipal**
- Wastewater and Water Pumps

- **Agriculture**
- Irrigation Pumping
Nationally, the Use of Distributed Energy Resources is Growing and Represent New Assets for the Grid.

- Over 2,000MW of deployed energy storage is anticipated in the US by 2020.¹
- Over 4,100 MW of solar PV installed in Q32016 in the US. California alone has an installed base of 15,200 MW, much of which is residential.²
- The US Electric Vehicle market is still small, but growing fast with 570,000 light duty plug-in vehicles registered in the US, a 3x fold increase from 2013.³
Non-Wires Opportunities Expected to Continue at BPA
With Analysis of Each Opportunity

Non-Wires is a strategy that is growing nationally:

- **Availability of attractive non-wire alternatives, the growing cost and time to build lines and a legislative/policy push** are leading to growth of T&D deferrals nationally.

- Over 60 Transmission non-wire deferrals in the **Eastern US** alone. NE-ISO has had $400 million in non-wires transmission deferrals over the last three years.

- **Con-Ed** has deferred a $1.2B substation investment in Brooklyn-Queens with Non-wires.

- **Southern Cal Edison** is going out for 250MW of non-wires measures in Orange County.
A DER Potential Study in BPA Service Territory is Now Underway (Will Support Non-Wires)

Two Components
1. Potential assessment
   - supply curves and achievable quantities for winter and summer seasons
2. Barriers assessment.

Three Asset Categories – All Sectors
1. Demand Response (primary)
2. Battery Storage
3. Distributed Generation (e.g. solar)

Data Sources
1. Literature review.
2. BPA, Customers, PNW stakeholders, and selected end consumer interviews (50-60) and surveys.

Vendor Chosen through RFP
Cadmus

What’s in it for BPA’s Customers:
Help public utilities in the region better capitalize on the potential of DERs which are growing exponentially throughout the country. In most all recent national surveys, addressing DERs shows up as a top concern of utilities.
South of Allston: Demand Side Assets as Part of Non-Wires Strategy

- BPA is adjusting its transmission planning process to include assessment of non-wires options.
- First application is the South of Allston flowgate.
- Each MW of DR translates to <1MW of flow relief when paired with generation north of Allston.
- Map depicts locational effectiveness of resources.
In 2016, BPA Went to the Market for Non-Wires Resources for South of Allston (I-5 Corridor)

- All Sources Request For Offers (RFO) including Demand Response - April 2016.
- Significant Market interest across asset types.
- Implementation in Summer 2017.

Fast Facts:

<table>
<thead>
<tr>
<th>Timeframe</th>
<th>5 year demonstration with initial 2 year acquisition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product</td>
<td>Day-ahead</td>
</tr>
<tr>
<td>Deployment</td>
<td>Mon-Friday, June – Sept, 14:00 - 22:00, 4-6 hour duration</td>
</tr>
<tr>
<td>Scale</td>
<td>200MW pairing of INC/DECs that provide 100MW of path relief</td>
</tr>
<tr>
<td>Portfolio Assets</td>
<td>Generation Demand Response (46MW) Battery Storage</td>
</tr>
</tbody>
</table>
The Future: Energy Storage and Electric Vehicles are on the Horizon

• Cost of storage is coming down and is becoming competitive on longer term contracts (e.g. 10 years).

• BPA cross-agency team is established to advance energy storage.
Storage Costs Continue to Fall and Trend is Expected to Continue with Scale

Lithium Ion Battery Costs

The Future: Nationally Energy Storage is Projected to Experience Strong Growth In the Coming Years

Source: GTM Research, March 2017
Solar Also Continues to Grow at a Rapid Pace and Prices Continue to Fall

USA Solar PV Annual Installations

<table>
<thead>
<tr>
<th>State</th>
<th>MW Cumulative Solar Installed</th>
<th>State Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>California</td>
<td>18,919</td>
<td>1</td>
</tr>
<tr>
<td>Idaho</td>
<td>359</td>
<td>17</td>
</tr>
<tr>
<td>Oregon</td>
<td>271</td>
<td>20</td>
</tr>
<tr>
<td>Washington</td>
<td>96</td>
<td>30</td>
</tr>
<tr>
<td>Montana</td>
<td>25</td>
<td>38</td>
</tr>
</tbody>
</table>

Source: Solar Energy Industry Association
Summary

• DER is **mainstream** and for many needs is profitable today.
• BPA is **well-positioned** for the future.
• There is **more to come** with emerging technologies and reduced costs to deploy.
• Currently, BPA’s **strongest case for DER** is in Non-wires alternatives (NWA)
Thank you