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# **Bonneville Power Administration Smart Grid Initiatives**

Lee Hall, BPA Smart Grid Program Manager

**October 5, 2010**

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# Agenda

- Why is Smart Grid Important to BPA and the Region?
- What is BPA Doing to Lead and Support Smart Grid?
- What are the first lessons in Consumer Engagement?

# What is Driving BPA's Smart Grid Strategy

**Regional  
and  
national  
drivers**

- **Cost containment**
- **Integration of Renewables** (e.g. Wind)
  - Pacific Northwest Region, Agency, and DOE priority
- **Climate Change**
- **6<sup>th</sup> Northwest Conservation and Power Plan**
- Mandatory standards for **reliability**
- **DOE priority**
  - An aging infrastructure
  - Smart Grid grants and roadmap
  - Opportunity for BPA to leverage federal \$ support

## Core Smart Grid Objectives

- ✓ Improve Grid Reliability
- ✓ Improve Grid Efficiency
- ✓ **Support End User Choices**
- ✓ Improve Integration of Renewables
- ✓ Develop Business Cases and Share Learning across Region

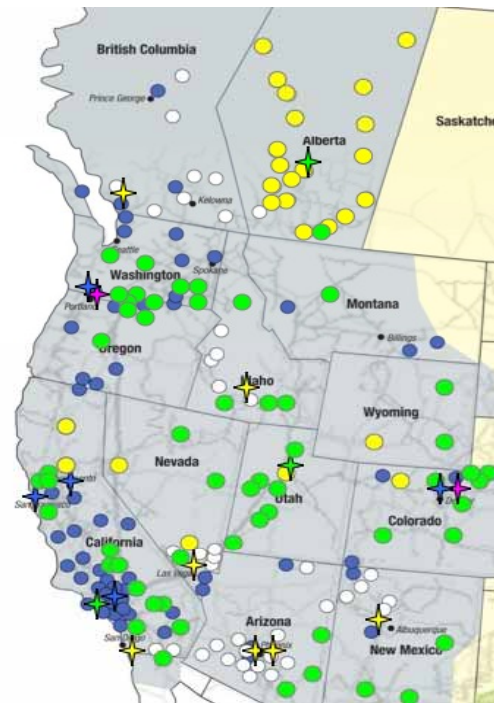
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*Optimize value to consumer, utilities and the region*

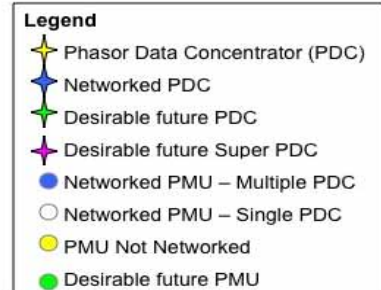


# Why is Smart Grid Important to BPA?

- New Smart Grid technologies will help increase operator situational awareness to improve reliability and reduce the likelihood of disturbances and blackouts.

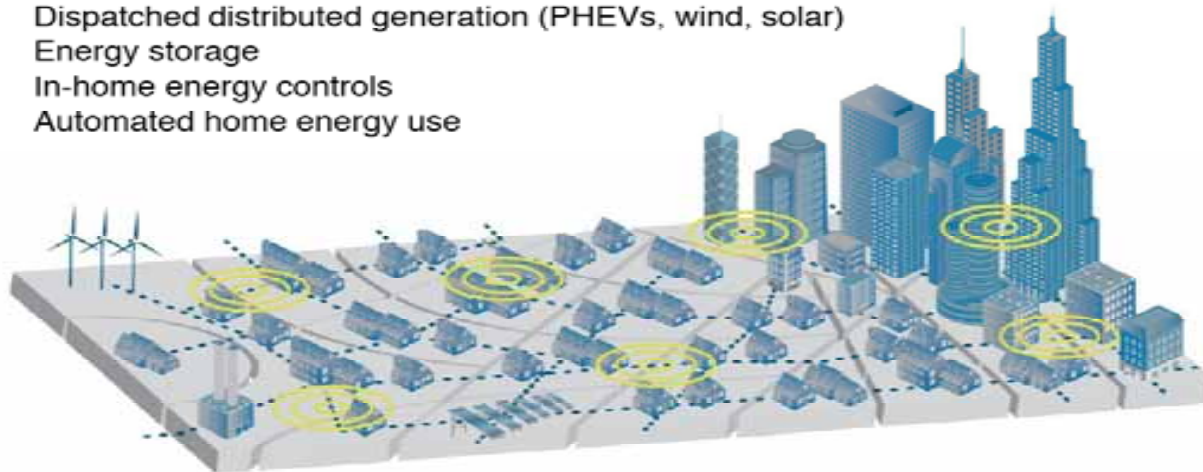


**Phasor Measurement Units (PMU) in the Western Interconnection**



# Why is Smart Grid Important to BPA?

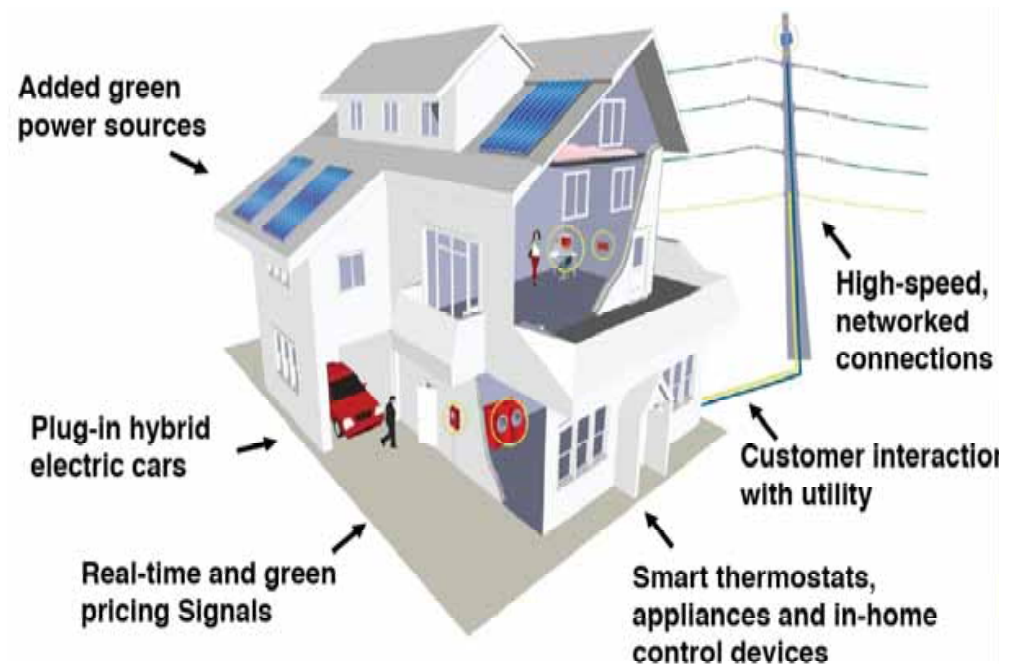
- Smart Grid will improve **grid efficiency and lower costs** by involving both generation and load in the effort to balance supply of and demand for electricity.
  - Involves the entire energy pathway from the power source to the home and all points in between
  - Rich in IT
  - High-speed, real-time, two-way communications
  - Sensors enabling rapid diagnosis and corrections
  - Dispatched distributed generation (PHEVs, wind, solar)
  - Energy storage
  - In-home energy controls
  - Automated home energy use





# Why is Smart Grid Important to BPA?

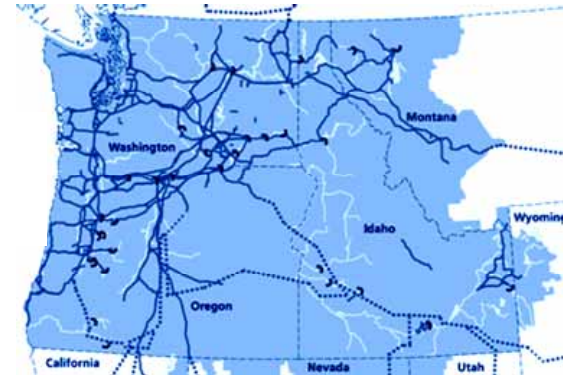
- End-use consumers will have greater information about their energy consumption, and will be able to make better, more economic choices in how they use electricity.



*Consumers are the center of Smart Grid*

# Why is Smart Grid Important to BPA?

- Develop and share **business case results** (quantitative and qualitative) for the region and for utilities to inform investment choices.



## *Regional Business Case Excerpt*

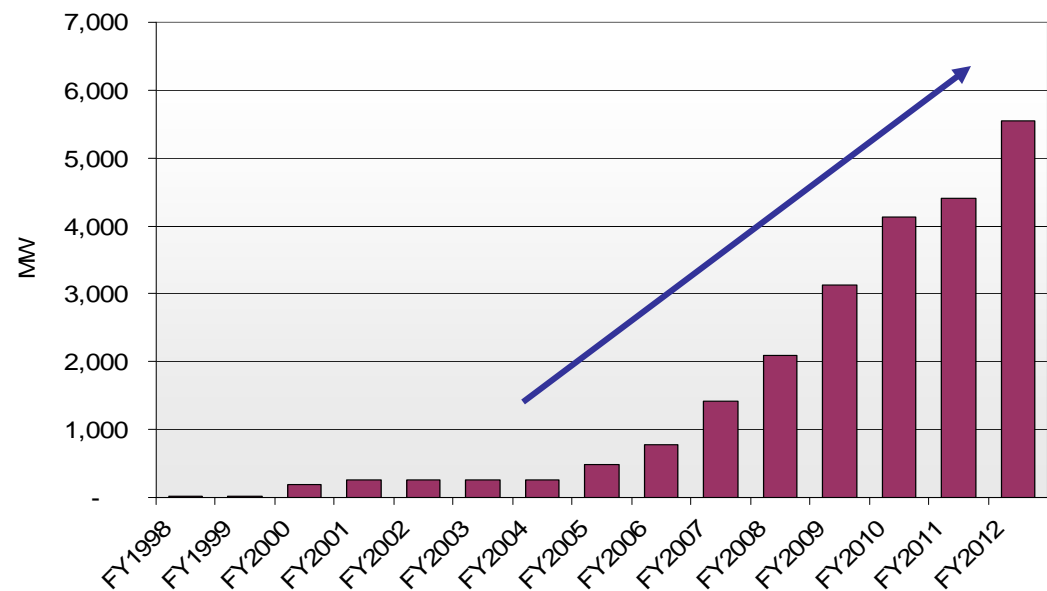
Benefit Area	Asset Category
Dynamic & Responsive Demand	<ul style="list-style-type: none"> <li>•Customer Consumption Display/Portal</li> <li>•End Use Remotely Controlled Interrupter/Switch</li> <li>•Energy Management System (EMS) - Residential</li> <li>•Energy Management System (EMS) - Commercial &amp; Industrial</li> <li>•Home Area Network</li> <li>•Electric Vehicle (EV) / Plug in Hybrid (PHEV)</li> <li>•Smart Appliances and Equipment</li> <li>•Smart Thermostat</li> <li>•End Use Equipment Sensors (e.g., Equipment Health, Consumption)</li> <li>•Distributed Storage (e.g., Batteries, Flywheels, etc.)</li> <li>•Advanced Meter Infrastructure (AMI) - Smart Meters</li> <li>•Meter Data Management System (MDMS)</li> <li>•Distribution Management System</li> <li>•Vehicle to Grid Infrastructure - 2 Way Flow</li> <li>•Advanced Visualization &amp; Analysis Software (Distribution)</li> <li>•Advanced Visualization &amp; Analysis Software (Transmission)</li> <li>•Central Storage (e.g., Batteries, Flywheels, etc.)</li> <li>•Transactive Control System</li> <li>•Integrated Utility IT System (IT hardware, software)</li> <li>•Two-way Communications Infrastructure (High Bandwidth)</li> </ul>

Which technologies are the winners and losers, and under what circumstances?

# Why is Smart Grid Important to BPA?

- A Smart Grid will better integrate more intermittent renewable resources (especially wind), helping to reduce greenhouse gas emissions, reduce the nation's reliance on fossil fuels, and result in a more sustainable energy production and delivery system.

Wind connected to BPA's Transmission System



*Leverage Consumer interest in Renewables*

# BPA Smart Grid Portfolio

BPA is pursuing these objectives through a portfolio of directly sponsored research and as a part of larger federal initiatives

BPA Sponsored Research	BPA Support of ARRA Funded Projects
<ul style="list-style-type: none"> <li>- Demand Response (utility pilots)</li> <li>- Storage (Ecofys project)</li> <li>- Electric Vehicles</li> <li>- Wind Integration</li> <li>- Response Based Voltage Stability Controls</li> </ul>	<ul style="list-style-type: none"> <li>- PNW Smart Grid Demonstration</li> <li>- Western Interconnect Synchrophasor Project</li> <li>- Workforce Development</li> </ul>

*Wide range of end-user engagement*

# BPA Is Pursuing Smart Grid Objectives through a Portfolio of Projects

*All have value – but need to show consumers the value*



## Projects/Research

	PNW Smart Grid Demonstration	WISP Synchronphasor Project	BPA Demand Response Pilots	Ecofys Pilot	Wind Integration Pilots	Electric Vehicle	OMET
Objectives	Improve Grid Reliability	Blue	Blue	Blue	Blue	Blue	Blue
	Improve Grid Efficiency	Blue	White	Blue	Blue	Blue	Blue
	Support End User Choices	Green	White	Green	White	Green	White
	Improve Integration of Renewables	Blue	Blue	Blue	Blue	White	White
	Develop Business Cases and Share Learnings	Blue	Blue	Blue	Blue	Blue	Blue

# Pacific Northwest Smart Grid Demonstration Project

- **Largest Smart Grid Demonstration Project in the Nation (50% funded by DOE through ARRA)**
  - **\$178 Million project led by Battelle Memorial Institute, Pacific Northwest Division**
  - Project participants include Battelle, BPA, utilities/ universities and infrastructure partners
  - 112 MW of responsive resources (loads and generation)
  - Five year duration



# BPA's Role in the PNW Smart Grid Demonstration

- **Coordinate with Battelle and Utilities on Business Case**
  - Data from utilities and project to inform Cost Benefit Analysis
- **Public Outreach and Communication**
  - Governments (states, Northwest delegation, Tribes, regulatory bodies, others)
  - Non-partner utilities, educational institutions
  - Energy organizations (WECC, NERC, Council, NWPPA, etc.)
  - Stakeholders, special interest groups, general public
  - Other regional demonstration projects
- **Support of Research and Infrastructure Design**
  - Support design of system
  - Integrate BPA data streams to system
- **Integration of BPA Operating Units**
  - Policy and standards development
  - Resource planning, wind integration, coordination with DR program

## BPA-Sponsored Smart Grid Projects

- ✓ **Demand Response Pilot Projects**
- ✓ **Electric Vehicles**
- ✓ **Energy Storage**
- ✓ Operational Multi-Gigabit Ethernet Transport
- ✓ Response-Based Voltage Stability Controls
- ✓ Wind Integration Research Projects
  - ✓ Pacific Northwest National Laboratory
  - ✓ Oregon State University



# Demand Response Residential Pilot Projects

<b>Orcas Power &amp; Light Cooperative</b>			<ul style="list-style-type: none"> <li>• Aclara AMI Technology</li> <li>• Water heater / thermostat control devices</li> <li>• Home area network capabilities</li> <li>• Real time communication through internet to study customer behavior</li> </ul>
<b>City of Port Angeles</b>			<ul style="list-style-type: none"> <li>• Water heating DR controls</li> <li>• In-home displays with home area network capabilities</li> <li>• Thermal storage devices for home heating</li> </ul>
<b>Mason County PUD #3</b>			<ul style="list-style-type: none"> <li>• Network configured for a Renewable Demand Response signal</li> <li>• Enhanced hot water heater control system to store renewable energy (wind)</li> </ul>
<b>Emerald PUD</b>			<ul style="list-style-type: none"> <li>• Cooper AMI Technology</li> <li>• Water heater control devices</li> <li>• Heat pump control devices</li> <li>• Programmable thermostat devices</li> </ul>
<b>Kootenai Electric</b>			<ul style="list-style-type: none"> <li>• Hot water heaters and thermostats</li> <li>• Aclara Technology</li> <li>• Testing of consumer acceptance and response</li> </ul>
<b>Central Electric</b>			<ul style="list-style-type: none"> <li>• Hot water heaters with Intermatic programmable timers</li> <li>• Addressing peak demand periods (e.g. morning)</li> </ul>

Coming in 2011 – Commercial Sector Pilots

# Energy Storage Pilot



## Smart End-use Energy Storage and Integration of Renewable Energy (Wind)

### Objectives:

- Facilitate the development and deployment of **end-use controllable loads to provide balancing services** in the BPA balancing authority and benefits to BPA customers
- Find and implement 1-3 commercial / industrial **end use storage projects**.
- Develop a **demand response business case** and **marketing materials** to support the participating utilities and other interested utilities

### Utility Service Areas:

- Lower Valley Energy, Eugene Water and Electric Board, Cowlitz County PUD

### Participants:

- Spirae, Steffes Corporation, EnerNOC, PNNL, Montana State, Renewable Northwest Project, Horizon Wind, Energy Northwest, Power and Conservation Council

# Electric Vehicles

- BPA is monitoring developments in plug-in electric vehicles and evaluating opportunities to work with customers

- Current Initiatives

## → Fleet Plug-in Electric Vehicle pilot

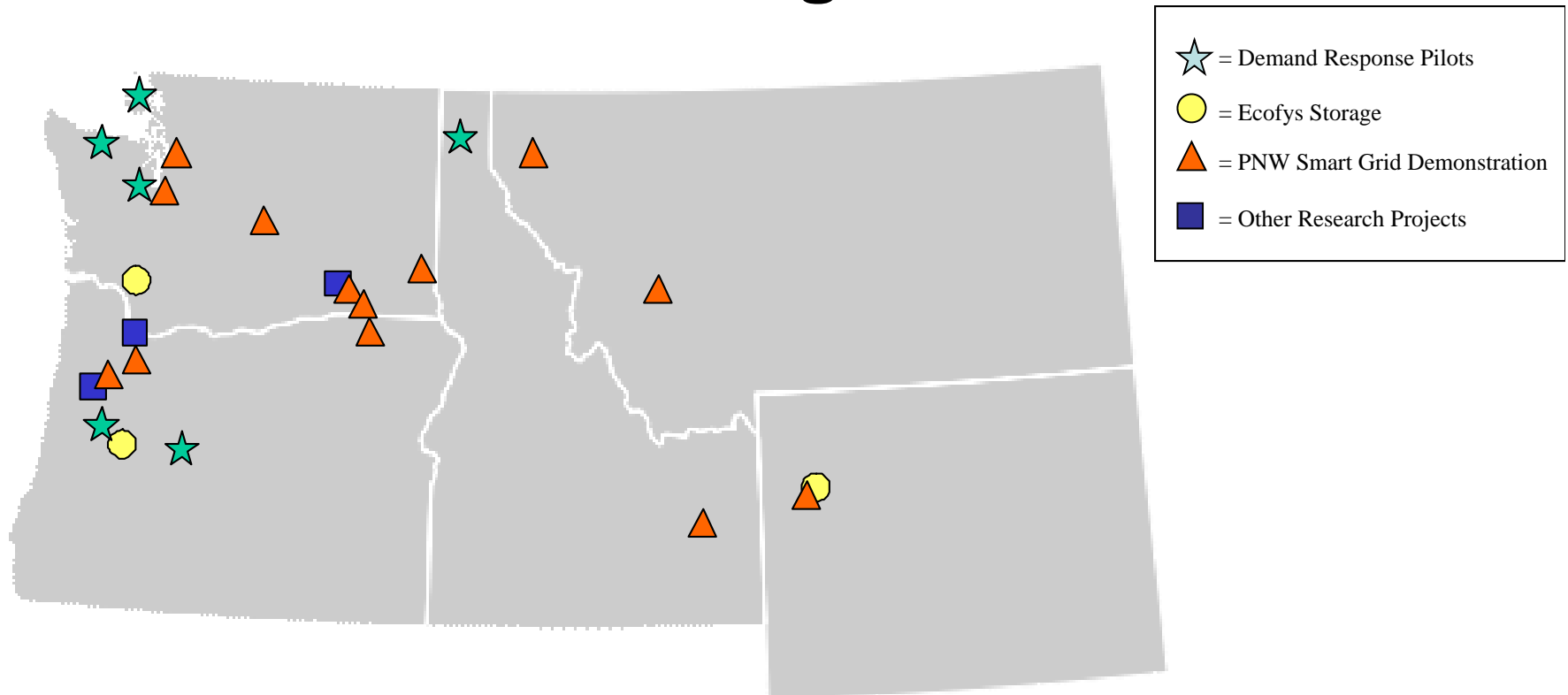
- Exploring opportunities to reduce BPA fleet costs, and meet DOE standards for reducing fossil fuel consumption
- Four EV **charging stations**
- Evaluating lease options/pursuing several **electric vehicles for the BPA fleet**



## → Hydro-Motion Plug-in EV Platform

- Assess interest in/feasibility of a **uniform technology platform** to help utilities support **electric vehicle charging** for end-use consumer and to aggregate these charging units as a tool to support management of variable renewable generation (e.g. wind) being added to the Northwest grid.

# Locations of BPA Smart Grid Projects in the Region



- Engaging 19 Pacific Northwest utilities
- Engaging national laboratories and educational institutions
- Diversity in climate, utility size, demographics, and technology, marketing and consumer engagement

Note: WISP PMU locations shown on separate map

# Variety of Approaches in Testing Consumer Response

- **Flathead Electric Cooperative**

Test end-user (member) response at four levels, from advanced meters with real-time outage management and water heaters, to smart appliance and home energy networks.

- **Mason County PUD #3**

Consumers able to track their energy usage, renewable integration (wind) and performance with respect to other project participants.

- **Central Electric Cooperative**

Voluntary sign-up for hot-water heater timers (for peak periods). Significant voluntary participation levels.

- **Orcas Power and Light**

Tests to assess if providing real-time information about electric usage change member's behavior?

- **University of Washington**

Test Room-by-Room measurement and display in 240 select student rooms



# Lessons Learned from Consumers...

- Education is the key to success
  - Consumer – build awareness and understanding
  - Employees - build knowledge to so that they can provide support
- Develop a detailed Communication and/or Marketing Plan and guiding principles
- Use customer focus groups, surveys, and research
  - Obtain end-user feedback on utility plans
  - Determine what motivates end users, degree of interest/apathy
  - Confirm interests (i.e., Auto notice of outages? Billing and/or DR Event Alerts? Electricity usage? Renewables? Choice?)
  - Be flexible! Feedback may highlight need to modify plans to gain end-user buy-in/support (example: backlash on “smart” anything)
  - Provides early warning of potential pitfalls, risks; can develop risk mitigation strategies

## Lessons Learned from Consumers...

- There is no such thing as over-communication
- If one does not yet exist, develop a data access and security/privacy plan NOW
- Tailor materials to match area demographics, interests
  - Multi-lingual
  - Age group (elderly vs. college student)
  - Connection with other programs (conservation, low-interest loans)
- Use a wide variety of techniques
  - Written (bill inserts, letters, door hangers, newsletters, FAQ flyers)
  - Telephone auto-dial messages and reminders
  - Electronic (websites, email)
  - Social Media (Facebook, Twitter, YouTube)
  - Face-to-face, in-person (example: Oncor's 18-wheeler)

## Lessons Learned from Consumers...

- Involve executives; use them in external communications
- Set clear expectations
  - Don't commit to reduced power bills or rates unless it's true
  - Provide event timelines so customers can plan for any changes
- Prepare, budget for support before, during, after roll-out
  - Dedicated call centers, dedicated telephone line (no "run around")
  - Trained knowledgeable staff
  - Extended hours may be needed
  - Work with customer as long as it takes (no max call-time targets)
  - Be ready to provide support until it's no longer an issue
- Keep consumers and stakeholders engaged
  - Update websites, etc. frequently with updated information
  - Plan for early successes and publicize them
  - Use testimonials



## Lessons Learned from Consumers...

- Inform and engage at the community level
  - Use community events as opportunities for outreach
  - Provide/post information within the community
  - Involve local institutions (schools, libraries, parks)
  - Continue to elicit ongoing feedback and input
- Identify other activities or events that could adversely impact the customer experience in advance
  - Tax changes or surcharges
  - Extreme weather
  - Have explanations ready before there is an issue
- Keep it simple: find the “easy button”
- Focus on making the best possible experience for the customer – be a trusted advisor

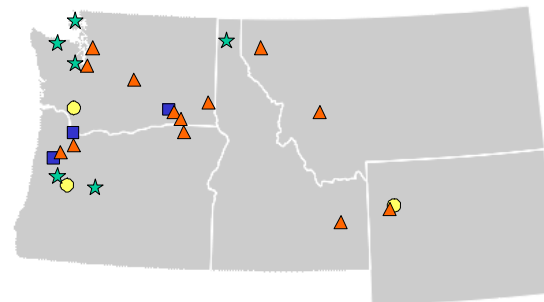
# BPA Smart Grid Outreach: Sharing Learnings in the Region

- **Education and Outreach**

- Workforce Development –  
Centralia College
- Consumer and Utility  
Awareness

- **Demand Response Sharing**

- Content being developed for  
regional awareness
- Share lessons and  
information from Pilots



## What Will We Learn and Share

- **Reliability:** What can we do to improve grid reliability?
- **Efficiency:** How can we get more out of our existing infrastructure?
- **Business Cases:** What technologies are most cost-effective based on utilities' circumstances?
- **Renewables:** What approaches are best for integrating the region's increasing portfolio of intermittent renewable resources?
- **Consumer awareness:** How can we foster consumer awareness for end-users to make informed choices about their energy use?
- **Employment:** What skills and training are needed for the smart grid related jobs of tomorrow?

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# Contact Information

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For more Smart Grid Information:

Battelle: [www.battelle.org](http://www.battelle.org)

PNNL: [www.pnl.gov](http://www.pnl.gov)

BPA: [www.bpa.gov/Energy/N/smart\\_grid/index.cfm](http://www.bpa.gov/Energy/N/smart_grid/index.cfm)

DOE OE: [www.oe.energy.gov](http://www.oe.energy.gov)

Smart Grid: [www.smartgrid.gov](http://www.smartgrid.gov)

Smart Grid Task Force:

[www.oe.energy.gov/smartgrid\\_taskforce.htm](http://www.oe.energy.gov/smartgrid_taskforce.htm)

Questions?



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