Pacific Northwest Smart Grid Demonstration Project

Northwest Power and Conservation Council

Lee Hall, BPA Smart Grid Program Manager
Tracy Yount, Battelle Electric Grid Research Manager

April 14, 2010
Agenda

• Smart Grid – What is it?
• PNW Smart Grid Demonstration Project
  – Background (OlyPen GridWise)
  – Regional Perspective
  – Goals & Objectives
  – Project Basics: Participant Roles, Budget, Timeline
  – PNW Utilities – What they are demonstrating
  – Support/Linkage to the 6th Power Plan
• Smart Grid ARRA in the PNW
• Summary
What is Meant by “Smart Grid”? 

- Smart Grid is a system that uses various technologies to enhance power delivery and use through intelligent two-way communication.
- Power generators, suppliers and end-users are all part of the equation.
- With increased communication and information, Smart Grid can monitor activities in real time, exchange data about supply and demand and adjust power use to changing load requirements.
- Empowers customers to choose to control their energy usage:
  - Smart meters
  - Home/building/industrial energy management/control systems
  - User information interfaces and support tools.
Smart Grid can be defined by its Components

- 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 and displays
- Automated home energy use
The End-user is the Centerpiece of the Smart Grid

- Added green power sources
- Plug-in hybrid electric cars
- Real-time and green pricing Signals
- High-speed, networked connections
- Customer interaction with utility
- Smart thermostats, appliances and in-home control devices
Olympic Peninsula Demonstration

Invensys

Clallam PUD & Port Angeles
n = 120, 0.5 MW DR

Internet broadband communications
Sequim Marine Sciences Lab
0.3 MW DR
0.5 MW DG

Johnson Controls

Johnson Controls

IBM

Market

MW

$
Results of Olympic Peninsula Project

• Residential customers will sign up for a real-time price if provided technology to automate their response

• Able to cap net demand at an arbitrary level
  – 16% less than the normal peak demand
  – Real capital cost savings when a $10M substation can be deferred or downsized

• Can easily synchronize thermostatically controlled loads to follow grid’s need for regulation
  – Demand resources easily respond over the short term
  – Excursions from normal set points are very small; minimal if any discomfort

• Implication: demand can provide ancillary service very analogous to regulation
  – Likely at far lower costs than power plants charge to ramp up/down

Remarkable Capabilities of this two-way Demand Management Network
Regional Smart Grid Outlook

- Unique in geographic scale and scope of grid engagement
- Seek to validate both local and regional grid benefits of smart grid
- Touches on key regional/national energy agenda for renewables, efficiency, reliability, consumer engagement and choice
- Linked to other smart grid and energy activities
  - WECC smart grid phasor build-out
  - Renewables integration
  - Efficiency and carbon benefits of smart grid
- Positions the region for leadership overall grid and energy agenda
Other Regional Smart Grid Activities

• Opportunity to include other regional smart grid deployments
• Consideration of transmission, renewable integration strategies, energy storage will be informed by smart grid demonstration
• Western Interconnection Phasor Network smart grid investment grant award ($108M)
  – Wide area monitoring and control
  – Aid renewable integration, unlock transmission
  – BPA, PacifiCorp, Idaho Power represent region

Phasor Measurement Units (PMU) in the Western Interconnection

This project is a cornerstone of the Pacific Northwest regional electric agenda. Coordination with other activities positions the region for continued leadership in transforming our electric power system.
Demonstration Project Overview

• Substantially increases smart grid asset installation in the region by purchasing and installing smart grid technology
  – $178 Million project led by Battelle
  – Project participants include BPA ($10M), 12 utilities ($52M), 5 project-level vendors ($27M). DOE matched with $89M.
  – Over 60,000 metered customers directly affected
  – 112 MW of responsive resources (loads and generation) engaged

• Demonstrates coordination of smart grid assets locally and across the region using innovative communication and control system
  – Hierarchical communication—from generation through transmission and distribution, and then onward to the end users
  – Transactive control—innovative incentive signal that coordinates smart grid resources to support regional needs for transmission, reliability, renewables, etc.
Goals and Objectives

Goals:
- Provide two-way communication between distributed generation, storage, and demand assets and the existing grid infrastructure
- Validate new smart grid technologies and inform business cases. Quantify smart grid costs and benefits
- Advance interoperability standards and cyber security approaches for transactive control
- Integrate rapidly expanding portfolio of renewable resources

Objectives:
- Manage peak demand
- Facilitate integration of wind and other renewables
- Address constrained resources
- Select economical resources
- Improve system efficiency
- Improve system reliability
  - Load Management
  - Conservation Voltage Reduction
  - Distributed generation

Regional effort extensible to large portions of the United States
Project Structure / Roles

- Battelle Memorial Institute, Pacific Northwest Division
- Bonneville Power Administration
- 12 utilities and their vendors
- 5 technology infrastructure partners
Financial Participation by Entity

- **Avista**: 21%
- **BPA**: 11%
- **PGE**: 11%
- **Idaho Falls**: 10%
- **IBM**: 9%

$178 Million (with DOE match)

Note: budgets as of December 2009
Demonstration Project Timeline

<table>
<thead>
<tr>
<th>Phase</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
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<td>Phase 1 - Concept Design</td>
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<td>Phase 2 - Build Out</td>
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<td>Phase 3 - Data Collection &amp; Analysis</td>
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<tr>
<td>Phase 4 - Cost Benefit Analysis &amp; Reporting</td>
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</table>

Periodic progress reports are required:
- Monthly financial reports to DOE
- Semi-annual program review meetings
- Technical reports
- Up to five presentations/meetings to DOE on final reports

- Complete contracts
- Design "system of systems" to connect subprojects to EIOC
- Install equipment at subproject
- Build 'system of systems'
- Sites up and running
- Gather two years of data
- Perform data analysis
- Finalize cost/benefit
- Draft transition plan
Project Basics

• Install and implement a unique distributed communication, control and incentive system
• Use a combination of devices, software and advanced analytical tools to enable consumers to manage their electric energy use
• Collect data over a 24-month consecutive period to provide insights into consumers’ behavior while testing new technologies

Key attributes:
• Leave an installed operational base of smart grid assets and successful operational strategies for the region
• Stimulate the regional and national economy by creating approximately 1,500 jobs and a vibrant smart grid industry
**Project Basics (cont’d)**

**Operational objectives:**

- Manage peak demand
- Facilitate renewable resources
- Address constrained resources
- Improve system reliability and efficiency
- Select economical resources (optimize the system)

Aggregation of Power and Signals Occurs Through a Hierarchy of Interfaces
BPA’s Role

• Coordinate with Utilities
  – BPA policies in the region
  – Utility advocate

• Public Outreach and Communication
  – Governments (states, Northwest delegation, Tribes, regulatory bodies)
  – Non-partner utilities, educational institutions
  – Energy organizations (WECC, NERC, Council, NWPPA, etc.)
  – Stakeholders, special interest groups
  – Other regional demonstration projects
  – General public

• 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

• Coordinate with Battelle on cost/benefit analysis and regional business case
Outreach and Education

Partner Utilities

General Public & End Users
- 12 million people in region
- 60,000 impacted customers

Educational Institutions
- Regional Colleges and Universities,
- University of Washington/SCL collaboration (sub-project site at UW)
- Washington State University/Avista collaboration (coursework)
- Establishment of new university partnerships, educational outreach
- Local Schools

Over 100 Non-partner Utilities
- Smart grid information sharing with other NW utilities

Energy Organizations
- Also, NW Energy Leadership Orgs:
  - Northwest Power and Conservation Council
  - Northwest Power Pool
  - Northwest Utility Trade Associations

Government
- States (via governor offices):
  - Washington (Olympia)
  - Idaho (Boise)
  - Oregon (Salem)
  - Montana (Helena)
  - Wyoming (Cheyenne)
- NW Congressional Delegation

Tribes
- Affiliated Tribes of Northwest Indians
- Tribe Utilities

Central Outreach
PNW Smart Grid Project Outreach Arm
Battelle’s Role

- Overall technical leadership and project management
- Responsible for all aspects of data management
- Operate the Electricity Infrastructure Operations Center (EIOC), a secure user facility to host partners’ computing hardware and software throughout the term of the Project
- Ties project together from an organizational point of view
Participants’ geographic, operations, and asset diversity adds to the regional view for the Demonstration.
## Utilities: Summary of Scope of Work

*(final SOW’s being completed - April 2010)*

<table>
<thead>
<tr>
<th>Utilities</th>
<th>Demand Response</th>
<th>Back-up / Distributed Generation</th>
<th>Distribution Automation / Management</th>
<th>CVR / IVVC</th>
<th>PHEV / Electric Vehicles</th>
<th>Diagnostics</th>
<th>End-user Portals</th>
<th>AMI</th>
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<tr>
<td>Avista Utilities</td>
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<td>Benton PUD</td>
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<td>Flathead Electric Coop.</td>
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<td>Idaho Falls Power</td>
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<td>Portland General Electric</td>
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<td>UW / Seattle City Light</td>
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**Avista Utilities**: Includes microgrid, creating of educational opportunity at WSU, and a test of a full range of DR measures.

**Benton PUD**: Explore interoperability and install a web-based interface for improved data management.

**City of Ellensburg**: Test renewable (solar, wind) technologies, evaluate incentives for investing in comm. renewable energy park, involving CWU.

**Flathead Electric Coop.**: An evaluation of four levels of residential smart grid technologies in Libby and near Kallispell.

**Idaho Falls Power**: Includes microgrid and solar sites at local public schools.

**Inland Power & Light Co**: Includes an investigation of retail incentives and/or rate structures as a means to increase adoption of DR programs.

**Lower Valley Energy**: Includes optimization of resources, reliability improvements in extreme weather locations at sites in Western Wyoming.

**Milton-Freewater City Light & Power**: Includes outage reporting, voltage and frequency stability; dlc for electric heat, hot water heater, cycling of a/c and city water pump.

**NorthWestern Energy**: Also, data management. Includes state capitol buildings complex in Helena and remote rural areas near Phillipsburg.

**Peninsula Light Company**: Improve reliability and defer construction of underwater cable service to island using direct load control and CVR.

**Portland General Electric**: Realize dynamically reconfigurable feeders with intentional islanding and improve integration of intermittent resources.

**UW / Seattle City Light**: A utility/university collaboration to create a "smart microgrid" with campus facilities mgt, administrators, faculty and students.
6th Power Plan Actions

• Gain a common understanding of the relationship between the Power Plan Action Items and the Smart Grid Demonstration Project Objectives

• The project will work with the Council staff to share information as much as possible over the next five years

• The following actions from the 6th Power Plan relate in one or more ways to the Demonstration Project detailed in the next two pages
<table>
<thead>
<tr>
<th>6th Power Plan Action Item</th>
<th>Interoperable Two-Way Communication</th>
<th>Smart Grid Cost Benefit Analysis</th>
<th>Standards, Cybersecurity and Transactive Control</th>
<th>Integration of Renewables</th>
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<tbody>
<tr>
<td><strong>CONSERVATION</strong></td>
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<tr>
<td>CONS-7</td>
<td>Policies to participate in processes to improve codes and standards</td>
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<td>CONS-10</td>
<td>Develop a library of savings estimates</td>
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<td>CONS-20</td>
<td>In order to ensure the long-term supply of conservation resources, develop and fund a regional research plan that directs development, demonstration, and pilot program activity.</td>
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<td>CONS-21</td>
<td>Develop a regional approach to support data needs for energy efficiency.</td>
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<td><strong>GENERATION</strong></td>
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<td>GEN-3</td>
<td>Reduce demand for system flexibility.</td>
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<tr>
<td>GEN-6</td>
<td>Evaluate flexibility augmentation options. This plan recommends development of wind and other renewable resources to offset carbon and natural gas price risks.</td>
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<tr>
<td><strong>DEMAND RESPONSE</strong></td>
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<tr>
<td>DR-1</td>
<td>Inventory demand response programs.</td>
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<tr>
<td>DR-2</td>
<td>Evaluate and demonstrate demand response programs.</td>
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<tr>
<td>DR-4</td>
<td>Monitor new programs.</td>
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<tr>
<td>DR-10</td>
<td>Improve Council modeling of demand response.</td>
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<tr>
<td><strong>SMART GRID</strong></td>
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<tr>
<td>SG-1</td>
<td>Monitoring smart grid technology.</td>
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<tr>
<td>SG-2</td>
<td>Smart grid demonstration.</td>
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<tr>
<td>SG-3</td>
<td>Develop evaluation methods</td>
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# 6th Power Plan (cont’d)

## Pacific Northwest Smart Grid Demonstration Operational Objectives

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<tr>
<th>6th Power Plan Action Item</th>
<th>Manage peak demand</th>
<th>Facilitate wind integration</th>
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<td>GEN-3</td>
<td>Reduce demand for system flexibility.</td>
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<td>GEN-6</td>
<td>Evaluate flexibility augmentation options. This plan recommends development of wind and other renewable resources to offset carbon and natural gas price risks.</td>
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<td>GEN-12</td>
<td>Planning for optimal development of the power system. The Council will work with the Wind Integration Forum</td>
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<td>Evaluate and demonstrate demand response programs.</td>
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<td>DR-4</td>
<td>Monitor new programs.</td>
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<td>No</td>
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<td>Improve Council modeling of demand response.</td>
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<td>SG-2</td>
<td>Smart grid demonstration.</td>
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<td>SG-3</td>
<td>Develop evaluation methods</td>
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<td>No</td>
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</table>
ARRA in the Pacific Northwest

• Smart Grid Investment Grants
  – Investment in SG technology deployment
  – Avista, Central Lincoln PUD, Idaho Power Company, Snohomish County PUD, PNGC
  – WECC – PMU Synchro-Phasors

• PNW Smart Grid Demonstration Project
  – ARRA funds directly to 12 PNW utilities

• Smart Grid Workforce Training
  – Oregon: Oregon Institute of Technology
  – Idaho: Critical Intelligence, Key Training Corp

Funds to the region:

$120 M

$52 M

$15 M
Direct PNW-SGDP Value

- Economic stimulus - $178 million over five years
  - 1,500 jobs at peak
  - Spur adoption of new technology
  - Updated infrastructure and improved reliability
- Cost-benefit analysis to guide utilities in making future technology investments
- Increased automation for utilities to deliver improved services and value
- System optimization through two-way communication from electricity generation to the consumer
- Potential reduction in greenhouse gases and carbon footprints through better integration of renewable resources
Contact Information

Lee Hall, BPA Smart Grid Program Manager
• 503-230-5189, ljhall@bpa.gov

Tracy Yount, Battelle Smart Grid Deputy Director
• 509-741-9990, tracy.yount@battelle.org

For more Smart Grid Information:
• Battelle:  www.battelle.org
• PNNL:  www.pnl.org
• BPA:  http://www.bpa.gov/Energy/N/smart_grid/index.cfm
• DOE OE:  www.oe.energy.gov
• Smart Grid:  www.smartgrid.gov