Pacific Northwest Smart Grid Demonstration Project

Northwest Power and Conservation Council

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Agenda

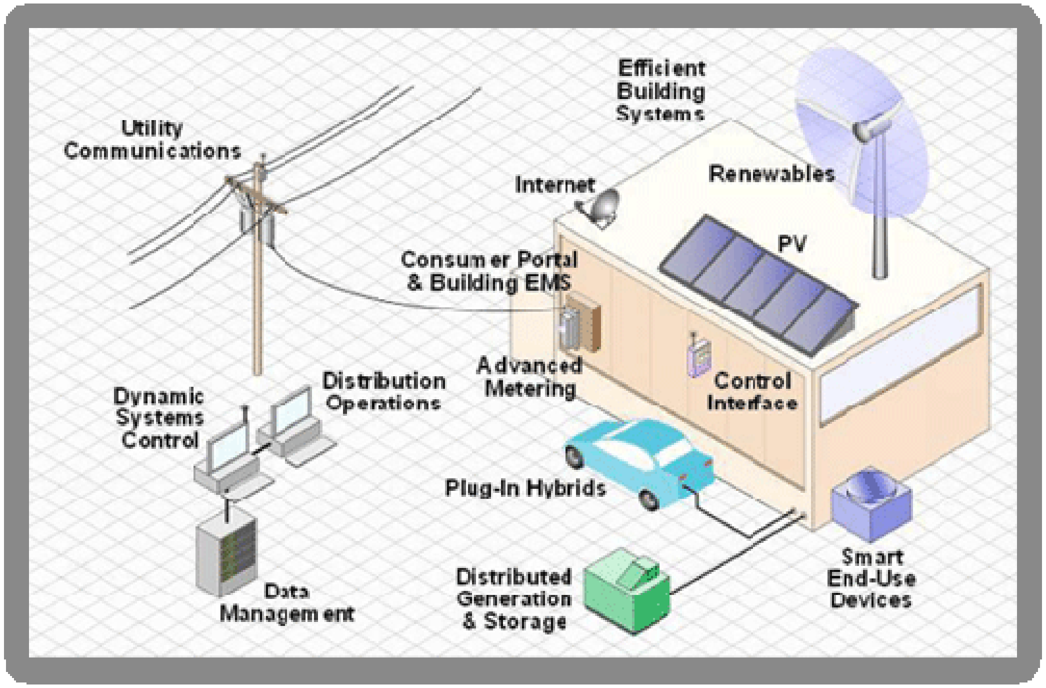
Pacific Northwest SMART GRID DEMONSTRATION PROJECT

- 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"?

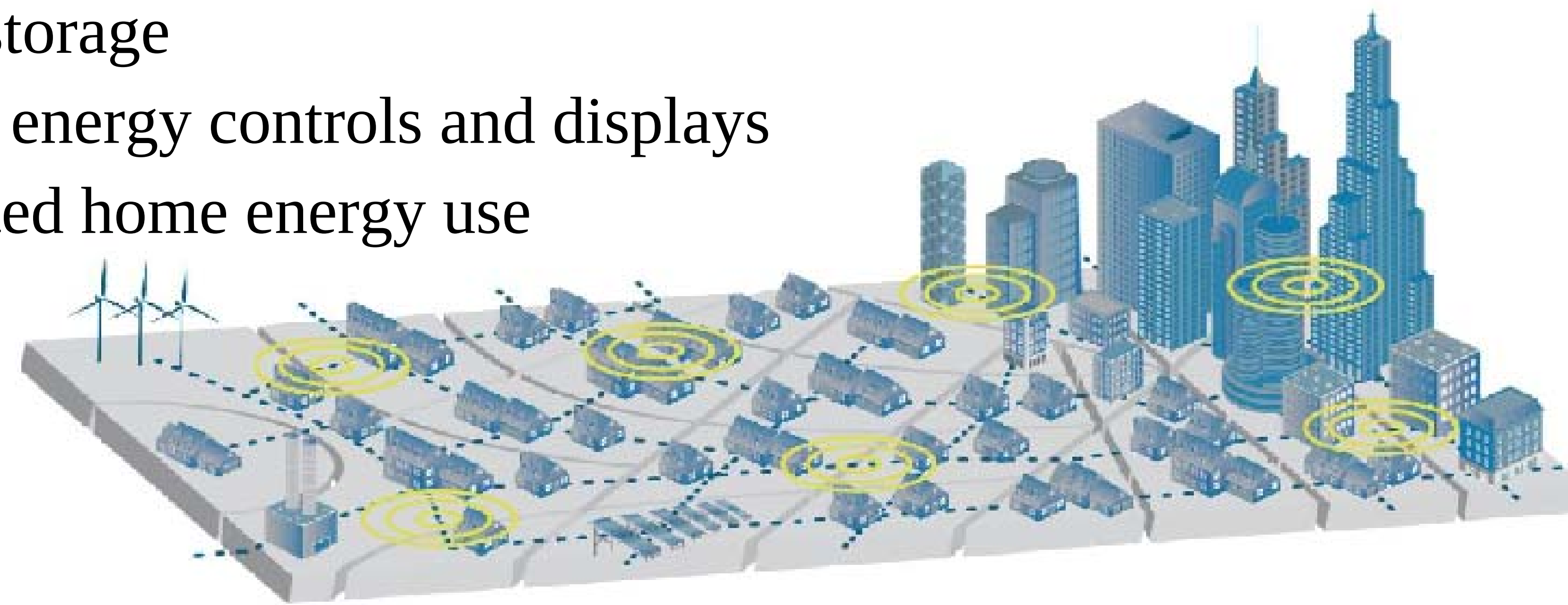
Pacific Northwest SMART GRID DEMONSTRATION PROJECT

- 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

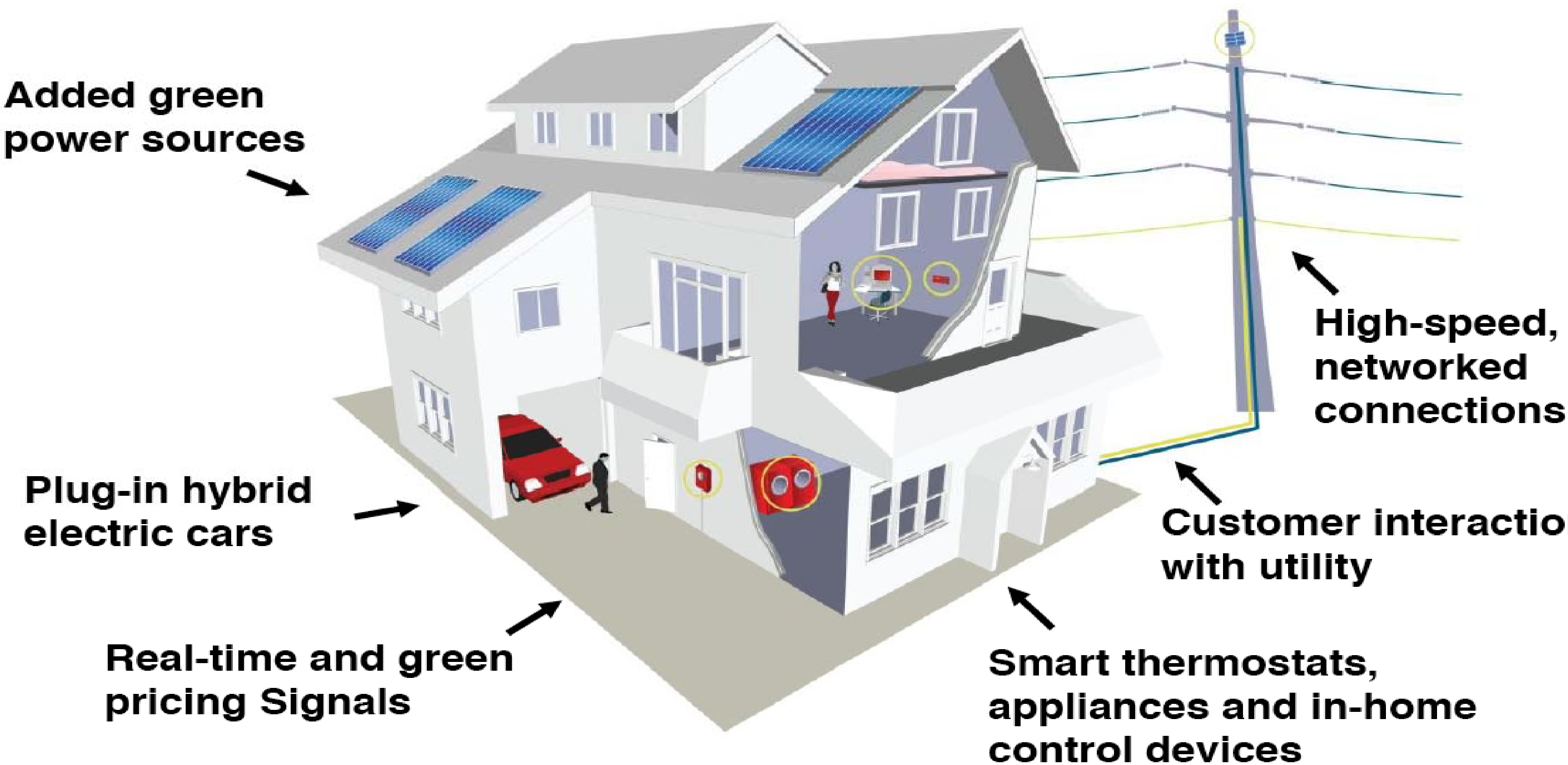


Smart Grid can be defined by its Components

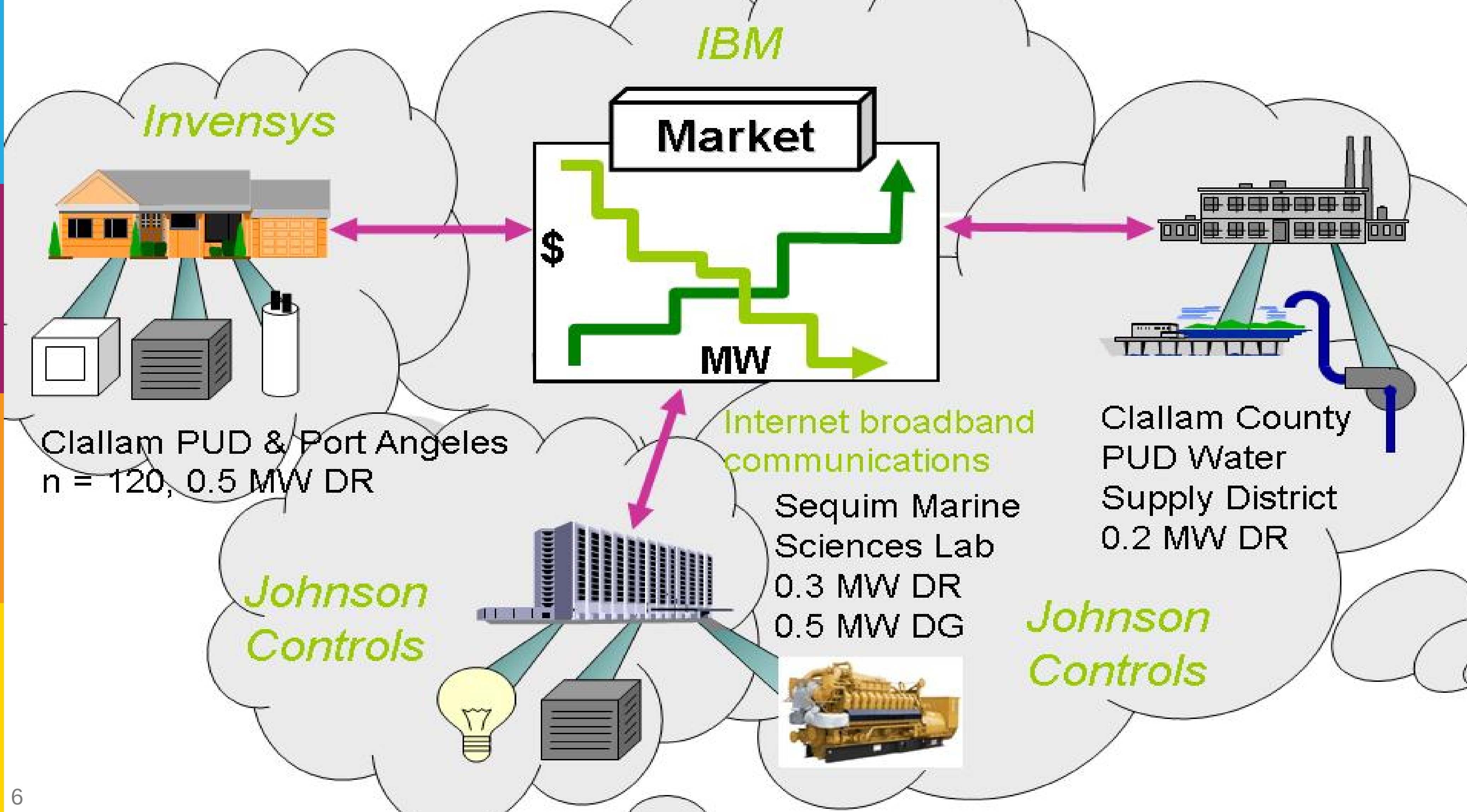
- Involves the entire energy pathway from the power source to the home and all points in between
- Rich in IT
- High-speed, real-time, two-way communications
- Sensors enabling rapid diagnosis and corrections
- Dispatched distributed generation (PHEVs, wind, solar)
- Energy storage
- In-home energy controls and displays
- Automated home energy use



The End-user is the Centerpiece of the Smart Grid



Olympic Peninsula Demonstration



Results of Olympic Peninsula Project

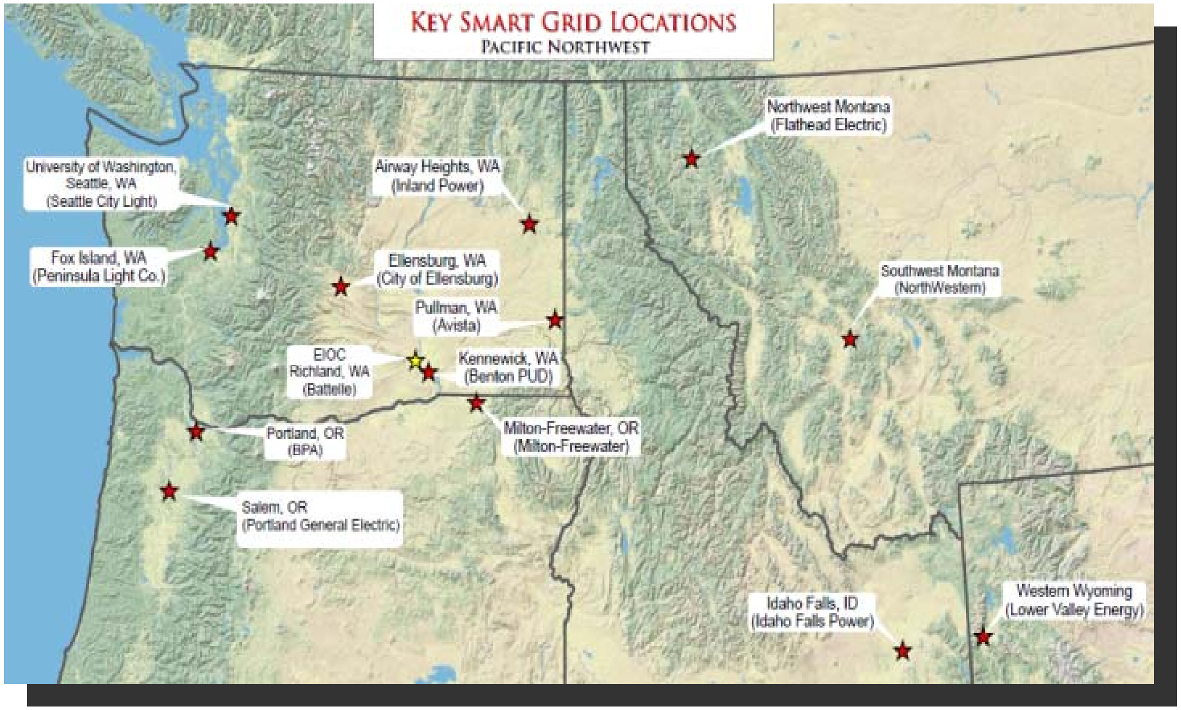
- Residential customers will sign up for a real-time price if provided technology to automate their response

- 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

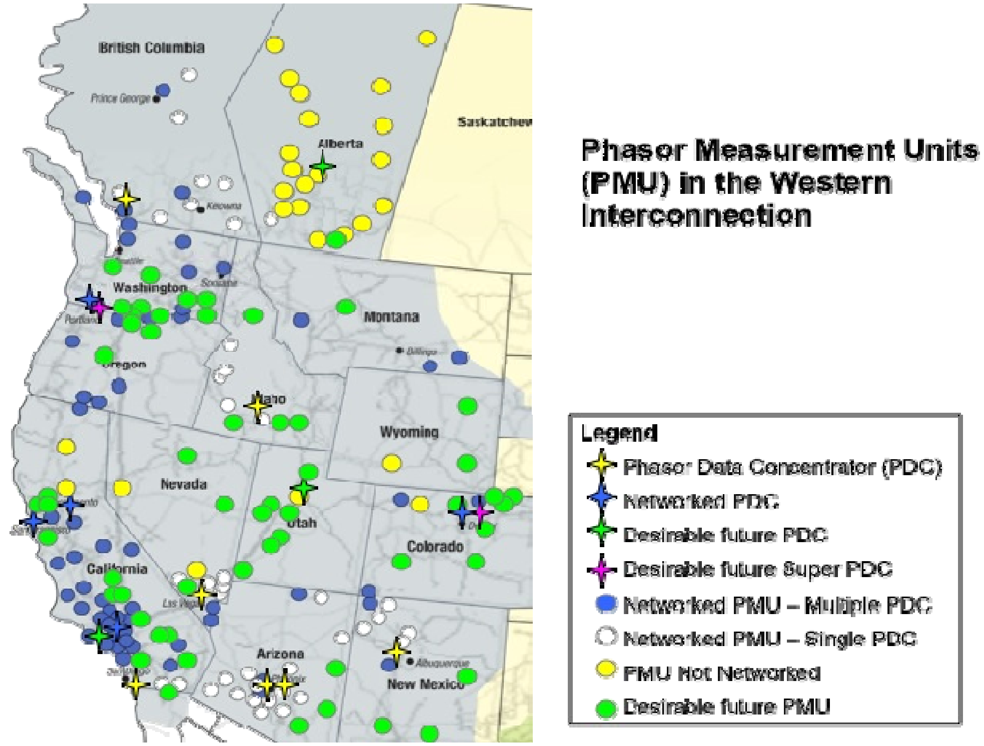
Regional Smart Grid Outlook

- 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



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

Pacific Northwest SMART GRID DEMONSTRATION PROJECT

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

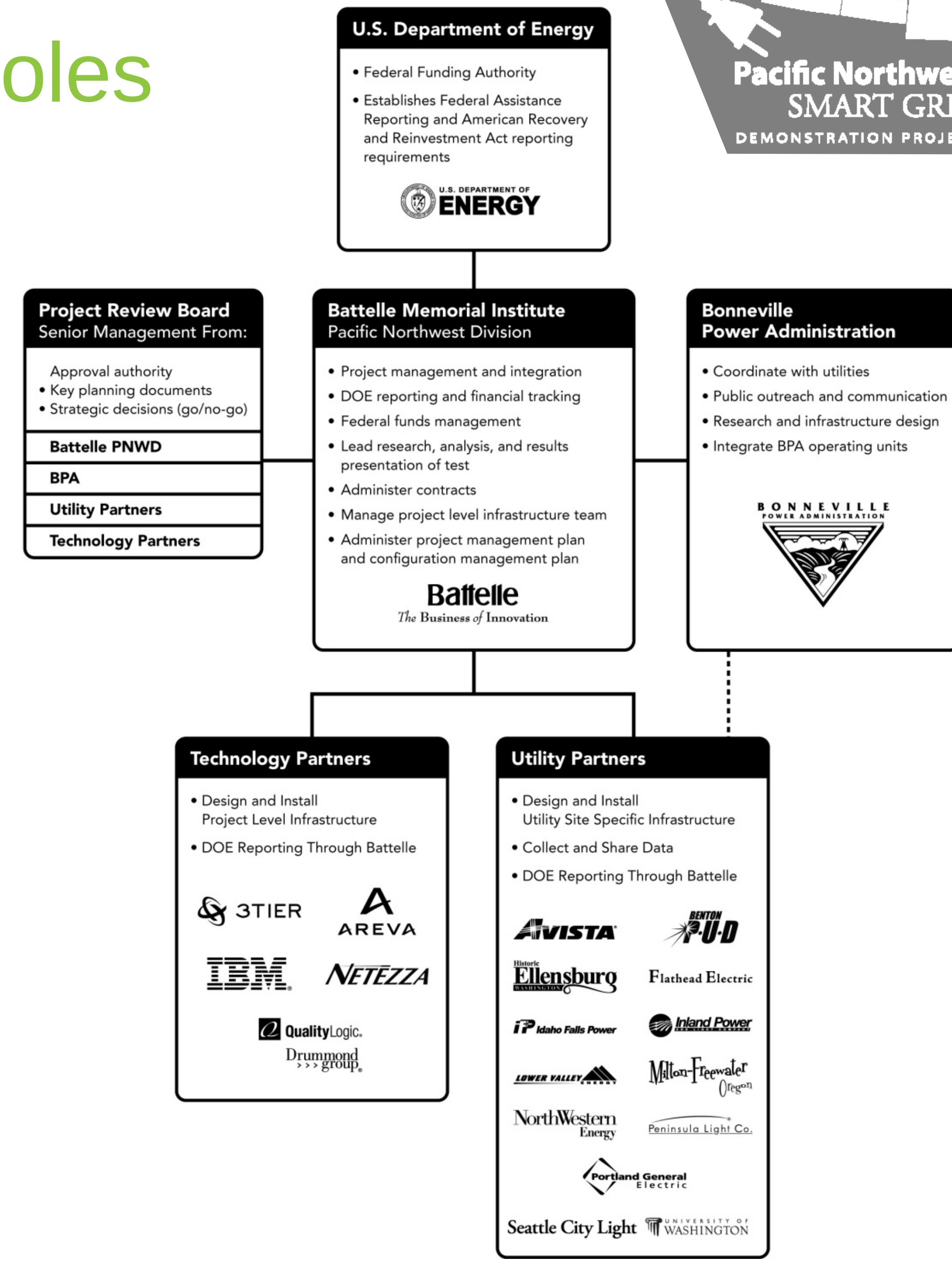
Objectives:

- 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

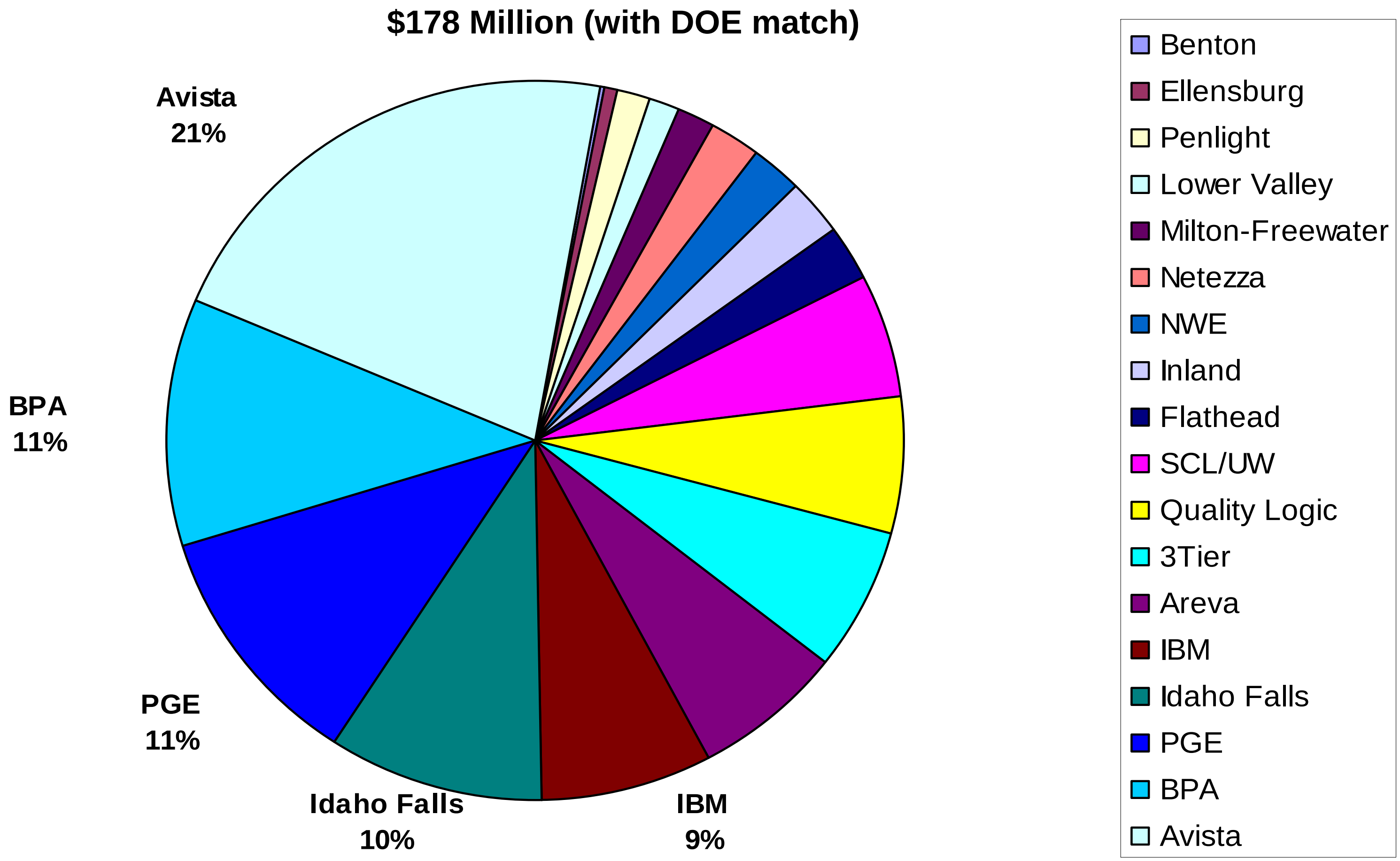
Regional effort extensible to large portions of the United States

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



Note: budgets as of December 2009

Demonstration Project Timeline

	2010		2011		2012		2013		2014	
Phase 1 - Concept Design	6 months									
Phase 2 - Build Out		24 months								
Phase 3 - Data Collection & Analysis						24 months				
Phase 4 - Cost Benefit Analysis & Reporting										6 months

- **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**

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

Project Basics

Pacific Northwest SMART GRID DEMONSTRATION PROJECT

- 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

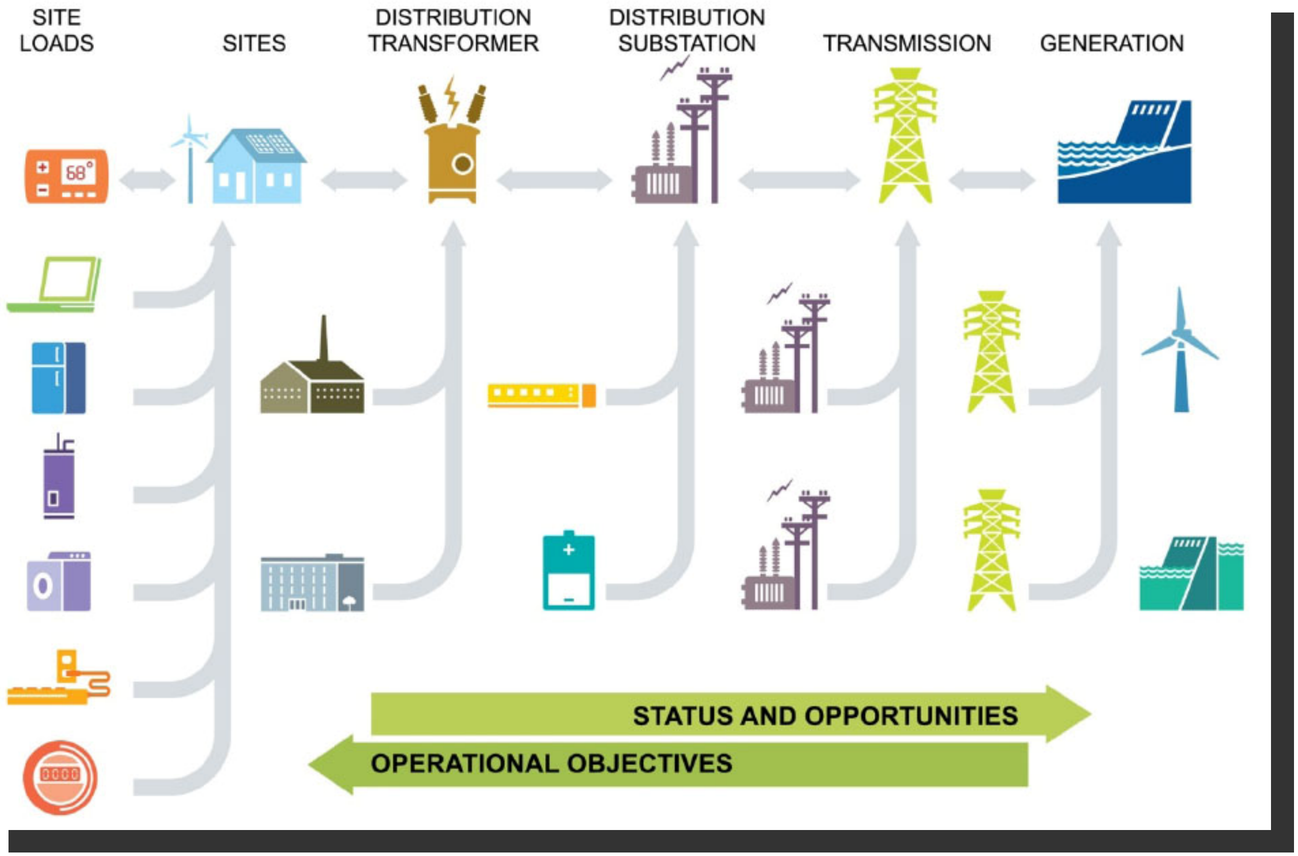
Key attributes:

- 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

Pacific Northwest SMART GRID DEMONSTRATION PROJECT

Partner Utilities

Utility
Utility
Utility
Utility

Central Outreach

PNW Smart Grid Project Outreach Arm

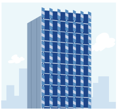
General Public & End Users

- 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
Western Governors Assoc, Local Gov & PUCs

Tribes

- Affiliated Tribes of Northwest Indians
- Tribe Utilities

Battelle's Role

Battelle
The Business of Innovation
Pacific Northwest Division

Pacific Northwest SMART GRID DEMONSTRATION PROJECT

- 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

Participant Site Locations

Participants' geographic, operations, and asset diversity adds to the regional view for the Demonstration

1. Portland General Electric – Salem, Oregon
2. Bonneville Power Administration – Portland, Oregon
3. Peninsula Light Co. – Fox Island, Puget Sound, Washington
4. University of Washington/Seattle City Light – Seattle, Washington
5. City of Ellensburg – Ellensburg Renewable Energy Park, Ellensburg, Washington
6. EIOC: Electricity Infrastructure Operations Center, Battelle Memorial Institute, Pacific Northwest Division – Richland, Washington
7. Benton PUD – Kennewick, Washington
8. Milton-Freewater City Light & Power – City of Milton-Freewater, Oregon
9. Inland Power & Light Co. – City of Airway Heights, Washington
10. Avista Utilities – Port of Whitman Business Park; Washington State University; City of Pullman (three sites), Pullman, Washington
11. Flathead Electric Cooperative, Inc. – Libby and Kalispell area, Northwest Montana
12. NorthWestern Energy – Helena and Philipsburg area, Southwest Montana
13. Idaho Falls Power – Idaho Falls loop microgrid; City of Idaho Falls (two sites), Idaho
14. Lower Valley Energy – Lincoln, Sublette, and Teton counties, Western Wyoming

Pacific Northwest SMART GRID DEMONSTRATION PROJECT

Utilities: Summary of Scope of Work

(final SOW's being completed - April 2010)

	Demand Response	Back-up / Distributed Generation	Battery / Storage	Distribution Automation / Management	CVR / IVVC	PHEV / Electric Vehicles	Diagnostics	End-user Portals	AMI	
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 incentrives and/or rate structures as a meanst to increase adoption of DR programs
Lower Valley Energy	■	■	■	■				■	■	Includes optimization of resources, reliablity 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

6th Power Plan (cont'd)

		Pacific Northwest Smart Grid Demonstration Primary Objectives			
	6th Power Plan Action Item	Interoperable Two-Way Communication	Smart Grid Cost Benefit Analysis	Standards, Cyber-security and Transactive Control	Integration of Renewables
CONSERVATION					
CONS – 7	Policies to participate in processes to improve codes and standards	■		■	
CONS – 10	Develop a library of savings estimates		■		
CONS- 20	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.	■			
CONS- 21	Develop a regional approach to support data needs for energy efficiency.		■		
GENERATION					
GEN-3	Reduce demand for system flexibility.	■			■
GEN-6	Evaluate flexibility augmentation options. This plan recommends development of wind and other renewable resources to offset carbon and natural gas price risks.				■
DEMAND RESPONSE					
DR-1	Inventory demand response programs.	■			
DR-2	Evaluate and demonstrate demand response programs.	■	■		
DR-4	Monitor new programs.	■	■	■	■
DR-10	Improve Council modeling of demand response.	■	■	■	
SMART GRID					
SG-1	Monitoring smart grid technology.	■	■	■	■
SG-2	Smart grid demonstration.	■	■	■	■
SG-3	Develop evaluation methods		■		

Pacific Northwest SMART GRID DEMONSTRATION PROJECT

6th Power Plan (cont'd)

	6th Power Plan Action Item	Manage peak demand	Facilitate wind integration	Address constrained resources	Improve system reliability	Improve system efficiency	Select economical resources
		Pacific Northwest Smart Grid Demonstration Operational Objectives					
CONSERVATION							
CONS- 20.	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.	■		■		■	
GENERATION							
GEN-3	Reduce demand for system flexibility.	■	■	■	■	■	
GEN-6	Evaluate flexibility augmentation options. This plan recommends development of wind and other renewable resources to offset carbon and natural gas price risks.		■	■			■
GEN-12	Planning for optimal development of the power system. The Council will work with the Wind Integration Forum		■				
DEMAND RESPONSE							
DR-1	Inventory demand response programs.	■		■		■	■
DR-2	Evaluate and demonstrate demand response programs.	■				■	■
DR-4	Monitor new programs.	■	■	■	■	■	■
DR-10	Improve Council modeling of demand response.	■		■	■		■
SMART GRID							
SG-1	Monitoring smart grid technology.	■	■	■	■	■	■
SG-2	Smart grid demonstration.	■	■	■	■	■	■
SG-3	Develop evaluation methods						■

ARRA in the Pacific Northwest

Pacific Northwest SMART GRID DEMONSTRATION PROJECT

Funds to the region:

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

$120 M

- PNW Smart Grid Demonstration Project
  - ARRA funds directly to 12 PNW utilities

$52 M

- Smart Grid Workforce Training
  - Washington: Centralia College, WSU, Incremental Systems Corp.
  - Oregon: Oregon Institute of Technology
  - Idaho: Critical Intelligence, Key Training Corp

$15 M

Direct PNW-SGDP Value

Pacific Northwest SMART GRID DEMONSTRATION PROJECT

- 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

Enduring smart grid infrastructure lays the foundation for future smart grid deployment in the Pacific Northwest

Contact Information

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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