Northwest Power and Conservation Council

September 27, 2012

MEMORANDUM

TO: Power Committee

FROM: Ken Corum

SUBJECT: Presentation from Bonneville on Demand Response

In the past few years Bonneville has been aggressively exploring the potential for demand response (DR). Bonneville has been examining both 'traditional' demand response that reduces load in peak hours and 'DR 2.0' that can increase or decrease load as the power system needs it, providing ancillary services such as load following and contingency reserves.

For decades Bonneville has been able to use the federal hydro system to cover peak loads and provide ancillary services. With load growth and addition of large amounts of renewable generation, mostly wind, on the system it now appears that Bonneville will need additional resource options in the future. Evaluating these options includes determining their value to the system. Bonneville must also develop protocols for using these options, which requires closer coordination between parts of the agency than has been necessary in the past. Implementing these options will involve at a minimum Bonneville system operators, Bonneville demand side program managers, Bonneville utility customers, and those utilities' retail customers, and probably will involve third-party aggregators in some cases as well. This undertaking is new to the agency, and challenging.

Bonneville has previously reported to the Council on their role in the regional Smart Grid Demonstration project, which includes demand response in 10 participating utilities. Bonneville and its coordinating contractor, Ecofys, have also reported to the Council on their pilot project testing the use of electric water heaters, space heaters and refrigerated warehouses to provide load following services to the power system. At the Power Committee meeting in Whitefish, Bonneville will discuss the issues they're dealing with in moving from the conceptual demonstrations of pilot projects to practical issues of scaling up to 'commercial' use of demand response.

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BPA Demand Response
NWPPC Power Committee Update

October 9, 2012

What BPA has been doing in demand response (DR)

- Finishing four years of field testing, pilots, modeling, and analysis
- Most of the current BPA-sponsored DR pilots will be completed by the end of 2012
- We've partnered with sixteen utilities:

- We've tested many different technologies and DR uses
- Together, BPA and our utility and consultant partners have spent ~$4.5 million on DR research from FY 2009 through FY 2012
- We have also been collaborating with other regional utilities to monitor what they are doing
  - Nine utilities in the Pacific Northwest Smart Grid Demonstration Project are testing DR
  - Existing commercial scale DR programs (e.g., Idaho Power and PacifiCorp each >300 MW)

Current DR pilots

	Utility	Sector/Expected MW				Technology/Planned Installs									
		Residential	Commercial	Irrigation	Industrial	Building management	Storage-battery	HVAC thermostat	In-home display	Process adjustment	Refrigeration/ cold storage	Thermal storage space heating	Thermal storage water hearting	Water heater controller	Water pumping
Current DR Pilots	Central Electric	0.2												403	
	City of Forest Grove				0.1						1				
	City of Port Angeles	0.4						90	90			30	20	500	
			1.8			1	1	2		4				4	2
					18.0-40.0					2					
	City of Richland	0.1			0.2						1		30		
	Clark Public Utilities		0.1			1									
	Columbia REA			3.0-5.0						1					2
	Consumers Power				0.3						2				
	Cowlitz County PUD	0.1 - 0.2											70		
	Emerald PUD	0.3						200				10	10	200	
	EWEB	0.1											50		
	Kootenai Electric	0.1-0.2						78						95	
	Lower Valley	0.1-0.2										6			
			0.1-0.2									3			
	Mason County PUD #3	0.1-0.2					2							100	
	Orcas Power & Light	0.4												410	
	United Electric Co-op			1.8											4

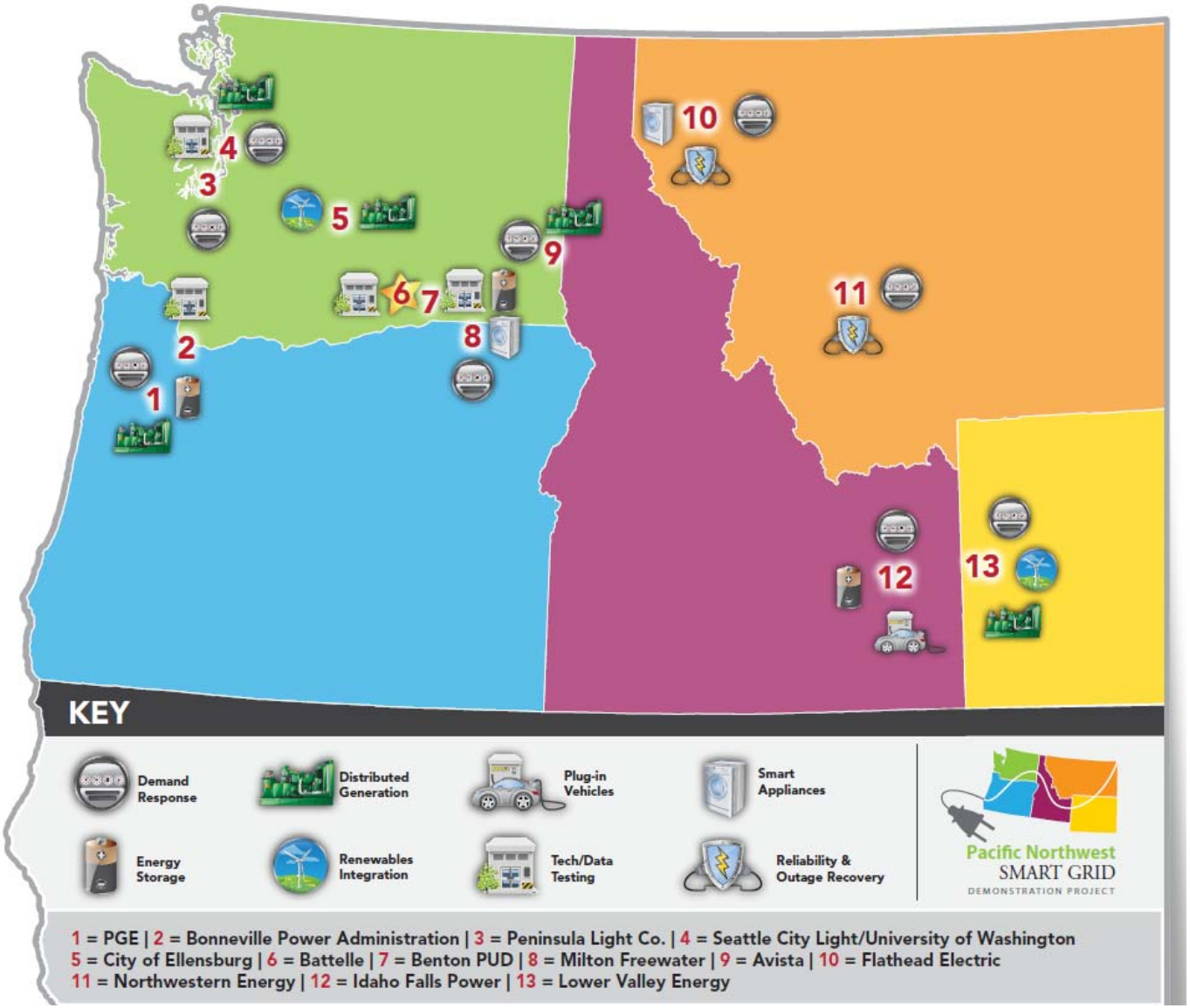
Pacific Northwest Smart Grid Demonstration Project: significant focus on DR

What:

- $178M, ($89M from partners, $89M DOE-funded)
- 5-year demonstration
- 60,000 metered customers in 5 states

Who:

- Led by Battelle Lab, BPA, 11 utilities, 2 universities and 5vendors



Pacific Northwest Smart Grid Demonstration Project: 9 of 11 participants involved in testing DR potential of different load types

Participant	Battery Storage	Commercial Load Control	Electric Vehicle	Energy Reports	HVAC	In-Home Displays	Programmable Thermostat	Smart Appliances	Water Heater Controllers
Avista					■	■	■		
Benton PUD	■								
Flathead Electric						■		■	■
Idaho Falls	■	■	■			■	■		■
Lower Valley Energy	■					■			■
Milton-Freewater									■
NorthWestern		■				■			■
Peninsula Light									■
Portland General Electric	■	■							■
University of Washington				■	■	■			

Objectives:

- Quantify costs and benefits
- Develop communications protocol
- Develop standards
- Facilitate integration of wind and other renewables

Evaluating multiple technologies for both reducing and increasing load

Testing many different technologies and DR uses, including:

- Commercial and public building load control
- Residential and commercial space heating energy storage
- Water heating energy storage and load control
- Industrial process load control and energy storage
- Large farm water management system load control and storage
- Small-scale battery energy storage
- Load increase using aquifer recharge opportunities

Demand response – potential to address regional challenges

- **Transmission expansion challenges**
- **Operational reserve and capacity constraints**
  - **Wind integration:** DR may be a tool for future balancing reserve needs
  - **River management:** BPA is approaching the limits of balancing reserves but must ensure sufficient margin to meet use requirements, including managing over-generation events
  - **Ease supply constraints** and operational demands during summer and winter peaks and large unit outages
- **Utility economics**
  - Rate design with demand charge creates incentives for customer utilities to invest in DR

What we have learned – nationally and regionally

- DR is cost-effective, available in predictable and reliable quantities and time periods and available from many end uses
- DR may cost less than other alternatives
- DR has flexibility to address multiple regional needs
  - DR can help address utility peaks and distribution system constraints, wholesale system peaks, balancing reserves, over-generation and non-wires opportunities
  - Potentially provides additional revenue stream for utilities
- Some utility customers have rate and market price signals to invest in DR
- We have identified four DR uses with potential near-term benefit for BPA and utilities:

DR Product	BPA Benefits	Utility Benefits
Capacity	• Lower cost power capacity • Economic opportunities	• LF: Lower wholesale power costs • Slice: Power capacity and economic opportunities
Balancing Reserves	• Potential for additional INC and DEC balancing reserve capacity	• Slice: Increased INC and DEC reserve capacity
Generation Oversupply Management	• Another tool to address OMP • Less need to curtail wind	• Productive use for oversupply energy • Potentially reduced 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 decrease

DEC = within-hour load increase

LF = Load Following BPA customer utility

OMP = Oversupply Management Protocol

VERBS = Variable Energy Resource Balancing Service

DR 2.0 – what it means to the Pacific Northwest

- Opportunity in NW to develop the resources from the ground up
  - Some utilities starting to develop programs
  - Regional coordination will likely maximize benefits
  - Proposing shift from pilots to commercial demonstration – 10s of MWs

- Use one resource to solve multiple requirements
  - Fast regulation – save wear and tear on the turbines
  - Balancing for wind
  - Addressing generation oversupply (need to add load overnight)
  - Defer transmission and distribution system investments
  - Peak load management
  - Capacity supply

- Complex solution
  - Can't increase load during utility peak
  - Some resources are seasonal
  - Cost causation / cost allocation

Sharing DR learnings – open to all interested utilities

- Kootenai Electric DR pilot evaluation report available now
- Planning webinar to discuss the Ecofys project business case and the cost/benefit of electric water heater controllers
- Will be evaluating pilots concluding in 2012
- Semiannual DR cross share with partnering utilities – open to others
- Semiannual participation in the Pacific Northwest Demand Response Project (PNDRP) regional information sharing meetings
- Planning for DR next steps, which will include utility outreach
- Discussions at annual BPA utility EE Summit

Moving forward – next phase

Moving forward with a two-pronged approach:

- Small-scale 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
    - Heat pump water heaters
    - Municipal wastewater treatment
    - Energy storage
- Developing plan to 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
  - Focus on areas with most likely near-term capacity needs
    - Transmission congestion
    - Utility and wholesale system peaks
    - Balancing reserve constraints
    - Oversupply
  - Objectives:
    - Determine best commercial arrangements, acquisition method, and equitable cost allocation
    - Evaluate dispatch by BPA and/or utilities
    - Achieve an operationally meaningful scale

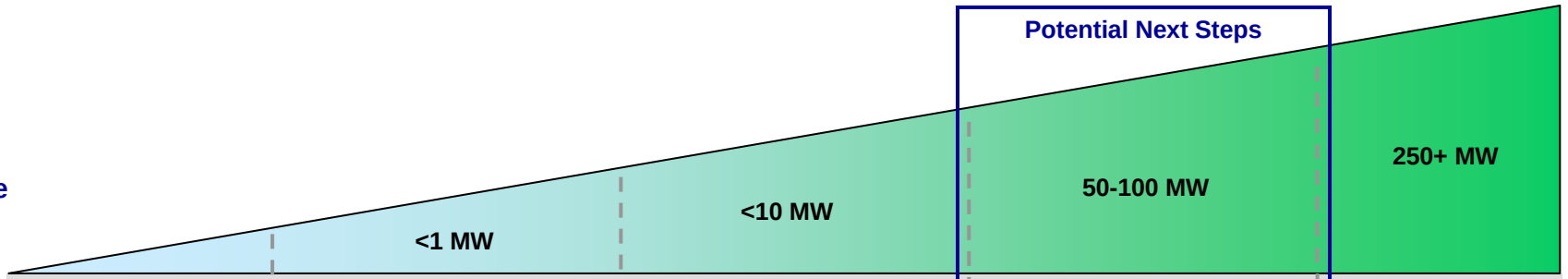
Learning objectives of the potential next phase of DR projects

- Viability of DR products to address regional needs
  - Alignment of characteristics with needs (e.g., notification period, duration, frequency, total annual hours)
  - Availability and reliability
  - Possible use for geographic-based distribution and/or transmission system deferrals
- Commercial/contractual arrangements
  - Contract type(s)
  - Contract elements – capacity, energy, performance requirements, etc.
- Benefits, challenges, and feasibility of jointly dedicating the same load to separate uses
- Technical and operational feasibility of dispatching different load types and sources
- Costs and benefits of selected DR projects to BPA, Load Following customers, Slice/Block customers, commercial aggregators, and potentially, variable energy resource suppliers
- Ability to automate DR dispatch by BPA and utilities
- Utility interest in continued DR investments

Questions and challenges of next phase

- Regional engagement
  - What is the best way to engage the region to assess interest, identify projects, and determine funding/cost allocation?
- Needs determination
  - The timing of regional needs is uncertain
    - Natural gas prices may remain low for many years, resulting in unexpectedly low cost combustion turbine peak energy
    - Wind producers may not want to buy additional balancing reserves to augment those provided by the FCRPS
    - An energy imbalance market might develop, reducing the need for and/or cost of balancing reserves
    - Within-in hour scheduling may become the norm across the western energy markets or in the PNW, reducing the need for balancing reserves
    - Overall load growth, including peak growth, is slower than previously projected
- Cost allocation
  - How do we ensure costs are properly aligned with benefits?

Building DR knowledge, experience and scale



	1984-2008	2008-2009	2010-2012	2013-2015	2016 +
Overview	▪ Individual projects designed to address a specific research or operational objective ▪ Not continuous	▪ Two residential and one commercial proof-of-concept pilot project projects ▪ Developed marketing materials and evaluation approach	▪ Additional residential pilots ▪ Added commercial and industrial pilots ▪ Largely focused on utility peak ▪ Introduced wind integration and load increase testing	▪ Larger scale (10s of MWs) ▪ Dedicated joint use projects ▪ Multiple acquisition methods ▪ Initial cost allocation methodology ▪ Joint separate BPA/utility dispatch	▪ Continue to scale larger based on evolving business needs ▪ Refined funding and cost allocation
Utilities / Partners	▪ Based on specific need or utility interest ▪ Example: OPALCO submarine cable deferral in late '90s	▪ Seattle City Light and LBNL ▪ Kootenai Electric ▪ Central Electric	▪ 12 additional utilities ▪ Joint project with TI (Ecofys) ▪ Many additional partners – commercial, academic, etc.	▪ 4-6 additional projects ▪ Blend of customer types ▪ Utility as aggregator and commercial providers	▪ Portfolio of varied DR tools ▪ Multiple utility and commercial partners
Sectors / Technology	▪ Manual event dispatch/notification ▪ Focused on peak load reduction	▪ Commercial building management systems ▪ Residential water heater and HVAC ▪ Curtailment only	▪ Added thermal storage, in-home displays, irrigation, cold storage and industrial processes ▪ Curtailment, load increase, HLH to LLH load shift	▪ Portfolio of projects rather than specific sectors or technologies ▪ Heavy focus on commercial and industrial loads ▪ Testing routine dispatchability ▪ More sophisticated technologies	▪ Likely to span all sectors ▪ Ongoing testing of emerging technologies
Benefits / Outcome	▪ Successful projects ensured reliability during deferral	▪ Technical feasibility ▪ Programmatic lessons ▪ Marketing refinement ▪ Open Auto DR success	▪ Technical feasibility and data ▪ Programmatic lessons ▪ Scalability assessment ▪ Testing dispatch based on wind and balancing needs	▪ Joint but dedicated use feasibility ▪ Delivery of MWs for BPA needs ▪ Significant regional DR learning ▪ Test commercial arrangements	▪ Program scaled to address multiple regional needs ▪ Ongoing evolution
Emerging Drivers	Transmission / distribution deferral	6th Power Plan encourages pilots	Oversupply TRM price signals – utility peak demand	Balancing reserve potential	Possible capacity drivers