Pacific Northwest Demand Response Project

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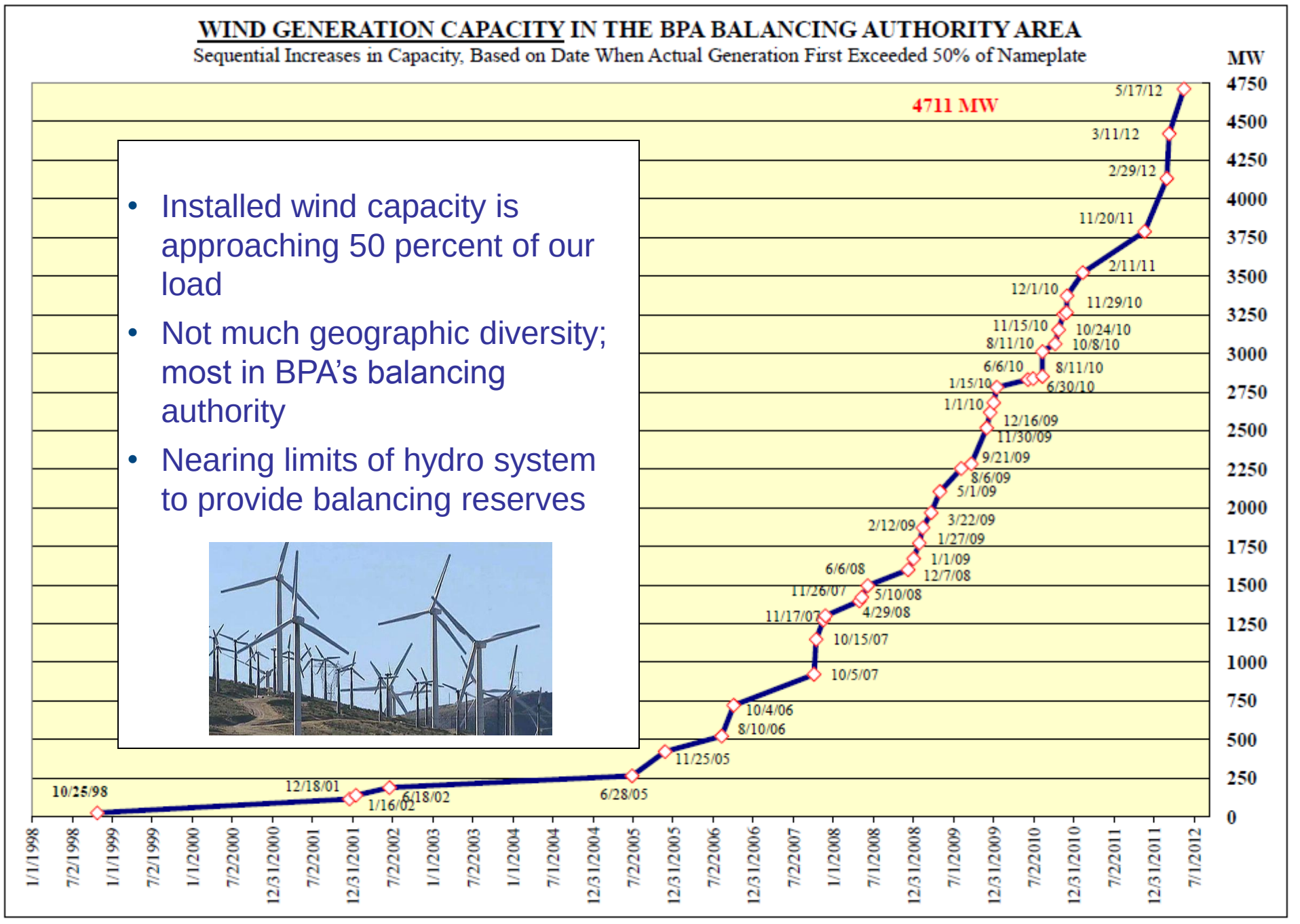
WIND GENERATION CAPACITY IN THE BPA BALANCING AUTHORITY AREA

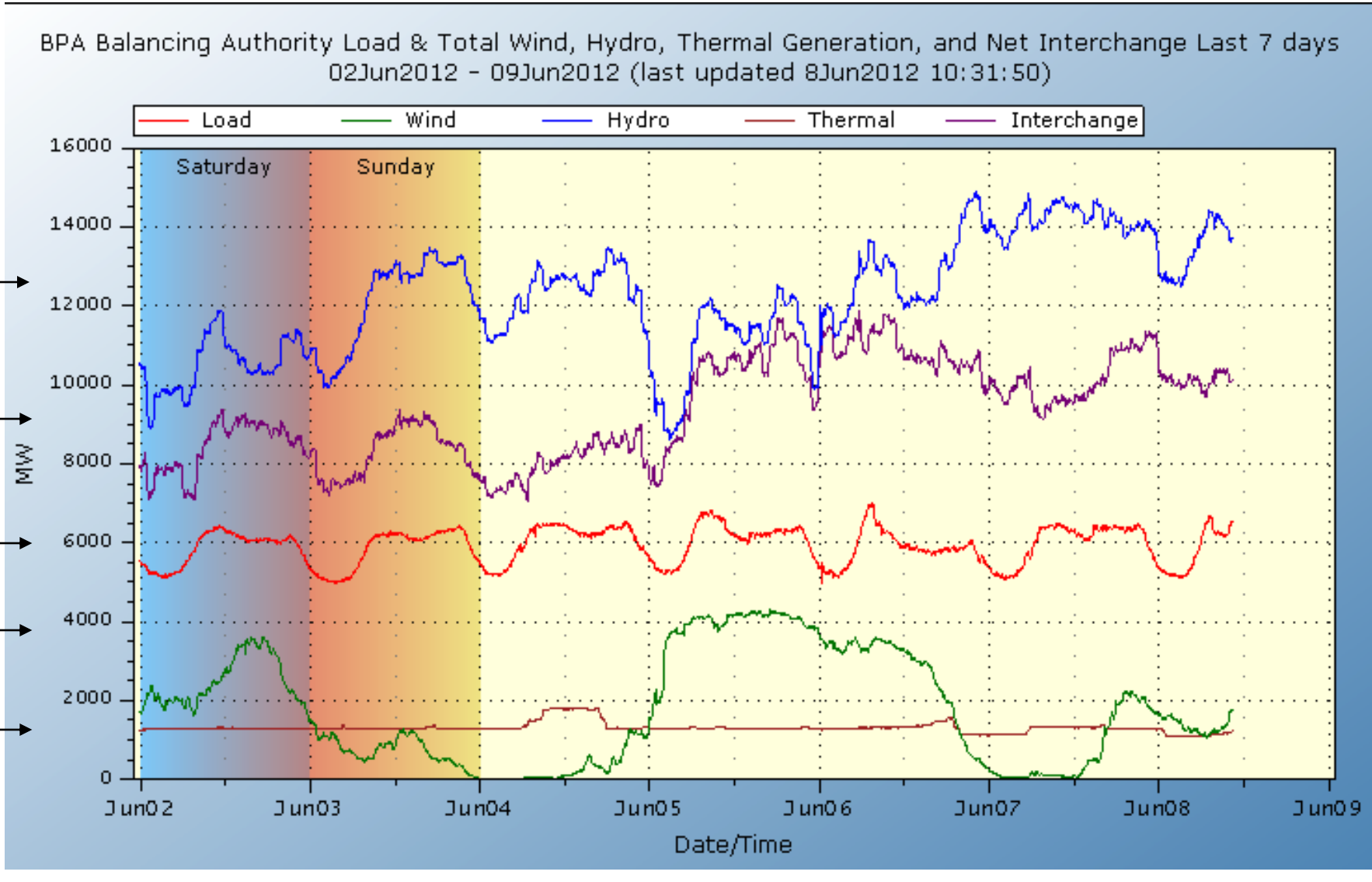
Sequential Increases in Capacity, Based on Date When Actual Generation First Exceeded 50% of Nameplate



- Installed wind capacity is approaching 50 percent of our load
- Not much geographic diversity; most in BPA's balancing authority
- Nearing limits of hydro system to provide balancing reserves

WIND_InstalledCapacity_current.xls 5/18/2012

Wind increasing -- more than 4,000 MW



hydro

inter-change

load

wind

thermal

Regional situational analysis – issues to address

1) Operational reserve and capacity constraints

- **Wind integration:** BPA faces significant balancing reserve demands
- **River management:** BPA is at the limits of balancing reserves but must ensure sufficient margin to meet multiple use requirements, including managing over-generation events
- **Ease supply constraints** and operational demands during summer and winter peaks and large unit outages

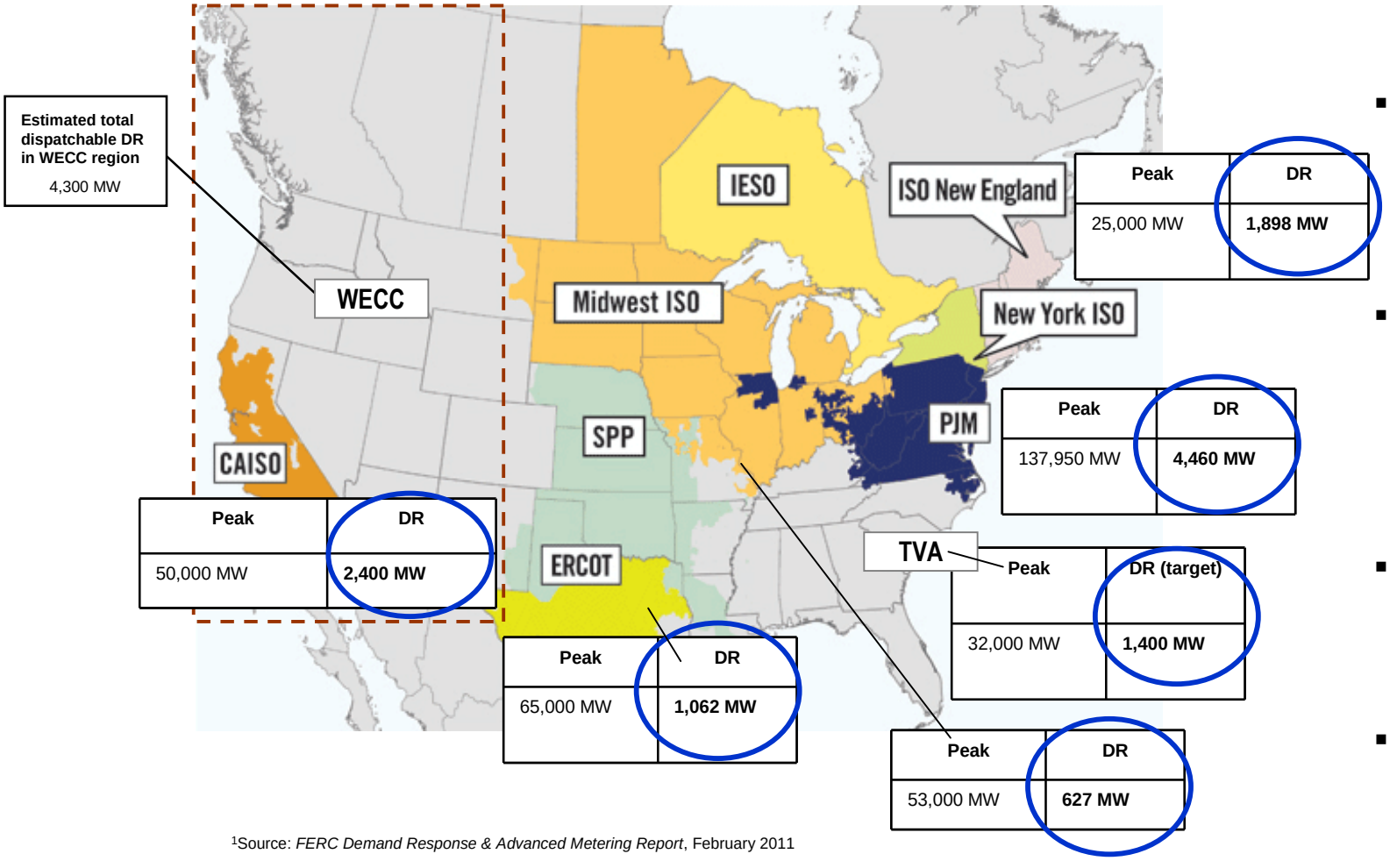
2) Transmission expansion challenges

3) Economic impacts on utilities

- Rate design with demand charge creates incentives for our customer utilities to invest in DR

Nationally – Demand Response is used extensively. Programs across US total at least 58,000MW[1]

Examples from *NERC 2010 Summer Reliability Assessment*



[1]Source: *FERC Demand Response & Advanced Metering Report*, February 2011

- **Available DR is an average of about 5 – 10% of peak in other regions**
- **Much of the DR in the nation is for capacity (peak management)**
- **In the PNW, Pacificorp and Idaho Power have had 300MW+ programs**
- **Cost is $4 - $7 kW/month for mature programs**
- **3rd Party aggregators have played a major role.**

Over the past four years in the Northwest, BPA and Utilities have partnered in a series of pilots and demonstrations

- **Invested in research**
  - Together, BPA Technology Innovation, BPA Demand Response, and our utility and consultant partners have spent ~$4.5 million on DR research from FY 2009 through FY 2012

- **Finishing four years of field testing, pilots, modeling, and analysis**

- **Sixteen utilities and BPA have partnered on DR pilots**

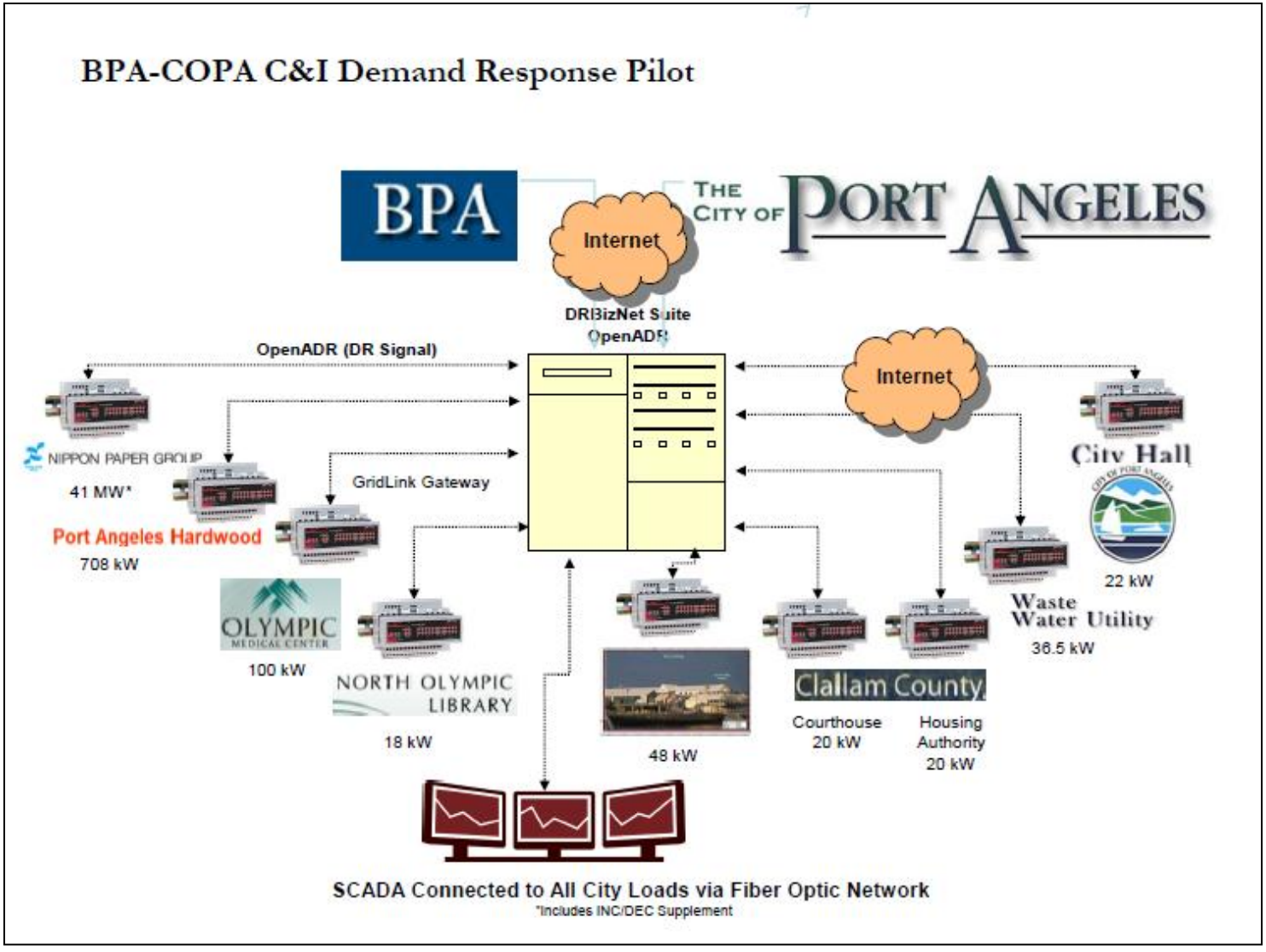
Central Electric Cooperative, Inc.
City of Port Angeles
Richland
Clark Public Utilities
Columbia Rural Electric Association
Consumers Power Inc.
Cowlitz County PUD
EWEB
Forest Grove Oregon
Kootenai Electric Cooperative
Lower Valley Energy
Mason County PUD 3
Orcas Power & Light Co-op
United Electric Co-op Inc.
Seattle City Light
The People's Power

- **Additionally, at least 44 utilities have, or plan to, implement AMI…a potential enabler for DR**

PNW DR pilots sponsored by BPA: technologies tested for residential, C & I, and irrigation applications

	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											100		
	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

OpenADR DR platform tested: We have a means to dispatch and measure Events – Now how do we develop a resource for use by both utilities and BPA?



We've tested the Grid OpenADR compliant platform to trigger events in several pilots:

- Used OpenADR, a standard protocol for DR
- Dispatch platform that can be used to coordinate multiple needs – by the utility for peak management (day ahead) and by BPA for balancing (10 minute notification)

We have piloted a DR Business Case Tool for Utilities to evaluate DR investments (in thermal storage)

Financial results per device (incl. costs for comm. & data kit)	Additional investment	Add. annual maintenance	Annual revenue	Payback time [years]	Annual return on investment	Costs	benefits
Steffes IWHC with 50 gallon tank	$ 1,058	11	$ 231	4.8	20%	$ -1,270	$ 4,611
Steffes IWHC with 105 gallon tank	$ 1,705	$ 17	$ 270	6.7	14%	$ -2,046	$ 5,404
Steffes ETS furnace (Forced air) (Incl. Air source Heat Pump)	$ 4,382	$ 74	$ [illegible]	[illegible]	14%	$ -5,858	$ 14,564
Steffes ETS furnace (Hydronic) (Incl. Air source Heat Pump)	$ 6,671	$ [illegible]	[illegible]	9.5	8%	$ -8,605	$ 15,910
Carina WISE controller 50 gallon retrofit	$ 630	$ [illegible]	$ 208	3.1	32%	$ -756	$ 4,160
One-Way WH Controller Switch	$ 300	$ 3	$ 90	3.5	29%	$ -360	$ 1,795

Sample #'s

Unique cost/benefit for each utility based on potential revenue streams:

- ✓ **peak reduction**
- ✓ **load shaping**
- ✓ **balancing service**

Leave behind Excel Tool. Review sessions with PNGC, Flathead Electric, and others

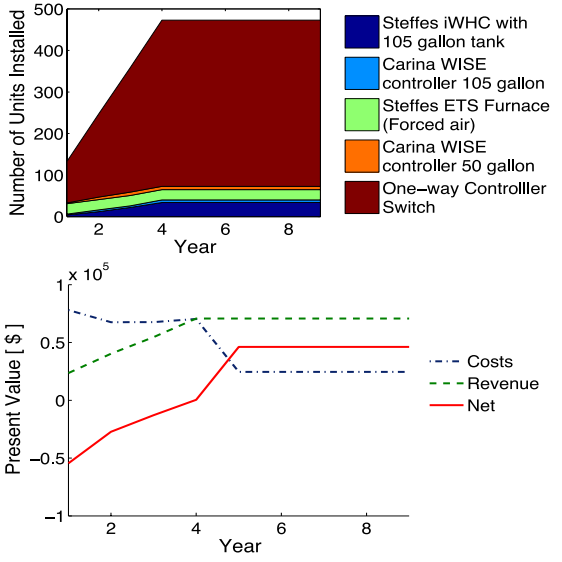


Figure: Example results of the business case model

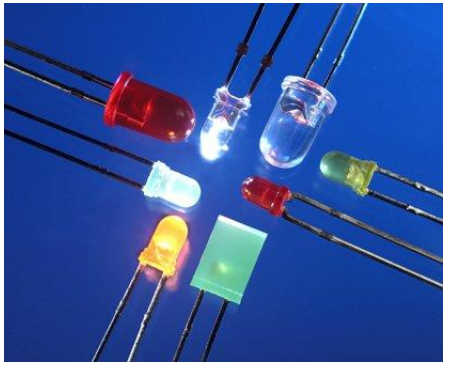
Moving forward with a two-pronged approach – TI program and DR commercial demonstration projects

TI Program:

- Proof of concept 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 ***– the only test of its kind in the nation***
    - heat pump water heaters
    - municipal wastewater treatment
    - energy storage
  - Developing focus for next year's TI portfolio

Moving forward with a two-pronged approach – TI program and DR business plan

TI Program (continued):



- Developing focus for next year's TI portfolio to test these technologies:
  - Lighting – specifically LEDs
  - Battery storage
  - Next generation of thermal storage (e.g., new types of water heater controls and space heating devices)
  - Whole home energy automation, including the use of home area networks including the use of smart thermostats, smart appliances, et cetera.
  - Heat pump water heaters and DR/EE
  - Small renewables and utility scale integration
  - Distributed generation resources
  - Communication systems and protocols, such as OpenADR
  - Aquifer recharge and other new load opportunities
  - Understanding DR potential of commercial building, irrigation and industrial energy control systems.

Moving forward with a two-pronged approach – TI program and DR business plan

DR Commercial Demonstration Projects:

- 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
  - Moving far beyond peak load management to address multiple purposes and objectives
  - Use proven technologies from DR pilots, including end-use technologies and DR management system
  - Leverage strong working relationships with utilities and other stakeholders

Moving forward with a two-pronged approach – TI program and DR business plan

DR Commercial Demonstration Projects (continued):

- Focus on areas with most likely near-term needs
  - Transmission congestion, power system peaks, balancing reserves and oversupply
- Objectives:
  - Determine best commercial arrangements, acquisition method, and equitable cost allocation
  - Evaluate dispatch by BPA and/or utilities
  - Achieve an operationally meaningful scale

Moving forward: A commercial demonstration phase, and continuation of collaboration

- **Joint Approach.** Work with utilities and regional groups to identify, design, and implement projects
- **Mix of Partners.** Select a mix of partners, including utilities (load following and slice, within and outside of BA) and at least one DR aggregator, utilities as aggregators – other ideas?
- **Cost Allocation.** The cost allocation for each project will be determined by an analysis of expected benefits, with each participating utility contributing based on the expected benefit they would receive
- **Scale.** Portfolio should be as simple as possible while still being commercially viable and operationally meaningful
  - Collaboration throughout agency to operationalize DR with a meaningful scale
  - Ideally 4-6 projects (excluding Technology Innovation and non-wires projects)
    - To test multiple DR products/uses, acquisition methods, geographies and load types with manageable cost and operations impact
    - $3.2 Million allocated in FY14 and FY15
  - Contract length: up to three years

Continue with the Two-pronged approach:
TI Program and
Commercial Demonstrations

We have identified four potential DR "products"

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	• Increased and lower cost INC and DEC reserve capacity • Increased VERBS revenue	• Slice: Increased INC and DEC reserve capacity • Reduced BPA costs over time
Generation Oversupply	• Decreased costs • Less need to curtail wind	• Productive use for oversupply energy • Reduced BPA 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 increase DEC = within-hour load decrease LF = Load Following VERBS = Variable Energy Resource Balancing Service

Several approaches envisioned for participation -- Bring BPA your ideas!

Single Utility Model

- Utility designs and implements a DR commercial demonstration project in its own service area
  - Could be implemented by utility itself or a third-party

Group of Utilities Model

- Group of utilities work together to design and implement a DR commercial demonstration project across their service areas
  - Could be implemented by utility itself or a third-party

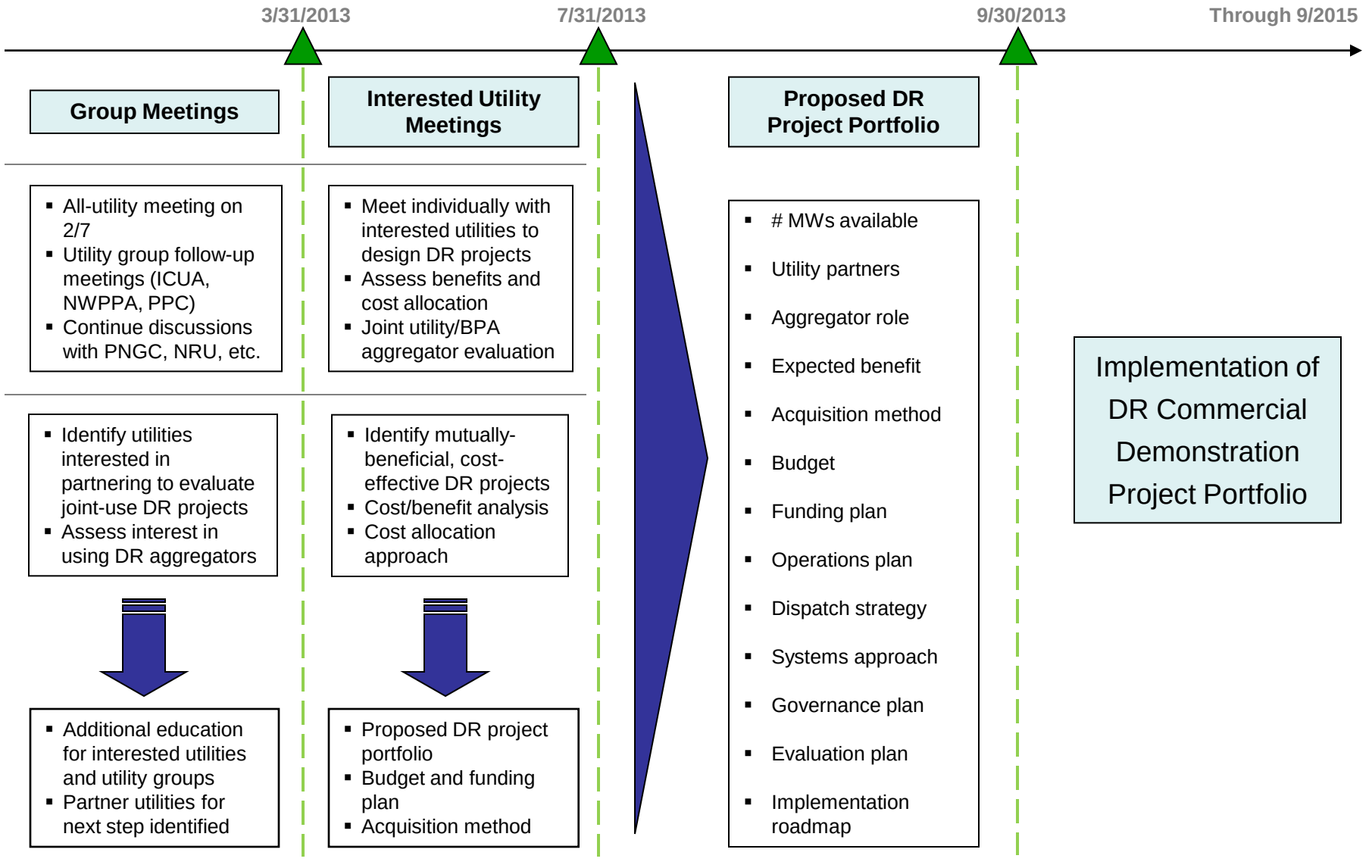
Utilities with DR Aggregator

- Join a BPA-coordinated team of utilities to evaluate and select a DR aggregator to implement a DR commercial demonstration project across service areas of participating utilities






Outreach and engagement approach



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