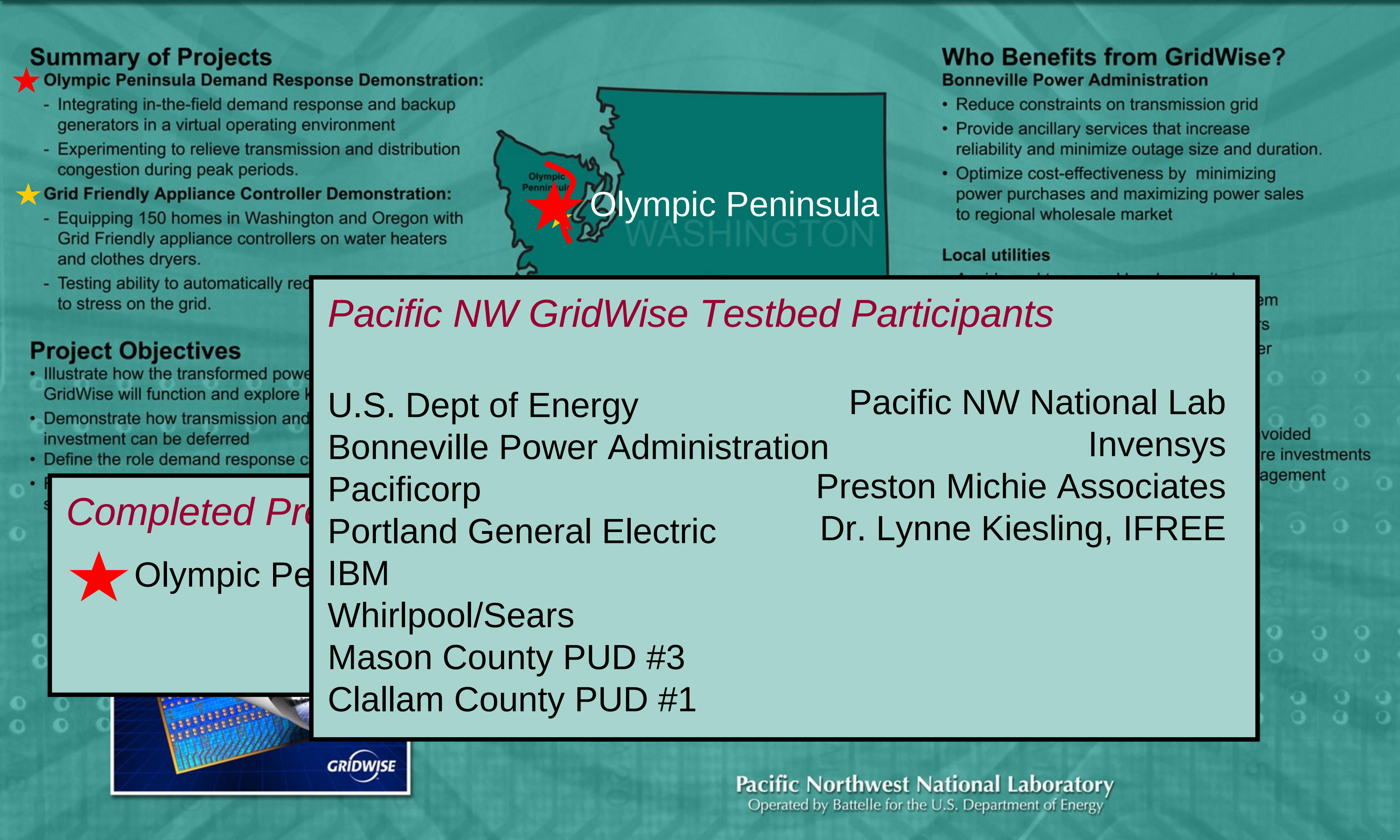
The Olympic Peninsula Project

Jane Snowdon, PhD, Global Research Leader, Smarter Buildings, snowdonj@us.ibm.com
Ron Ambrosio, Global Research Leader, Energy & Utilities, rfa@us.ibm.com
IBM Thomas J. Watson Research Center, Yorktown Heights, NY

Pacific NW GridWise™ Testbed Projects

Unleashing the power of distributed resources



Completed Pr

★ Olympic Pe

Pacific NW GridWise Testbed Participants

U.S. Dept of Energy	Pacific NW National Lab
Bonneville Power Administration	Invensys
Pacificorp	Preston Michie Associates
Portland General Electric	Dr. Lynne Kiesling, IFREE
IBM	
Whirlpool/Sears	
Mason County PUD #3	
Clallam County PUD #1	

Environment

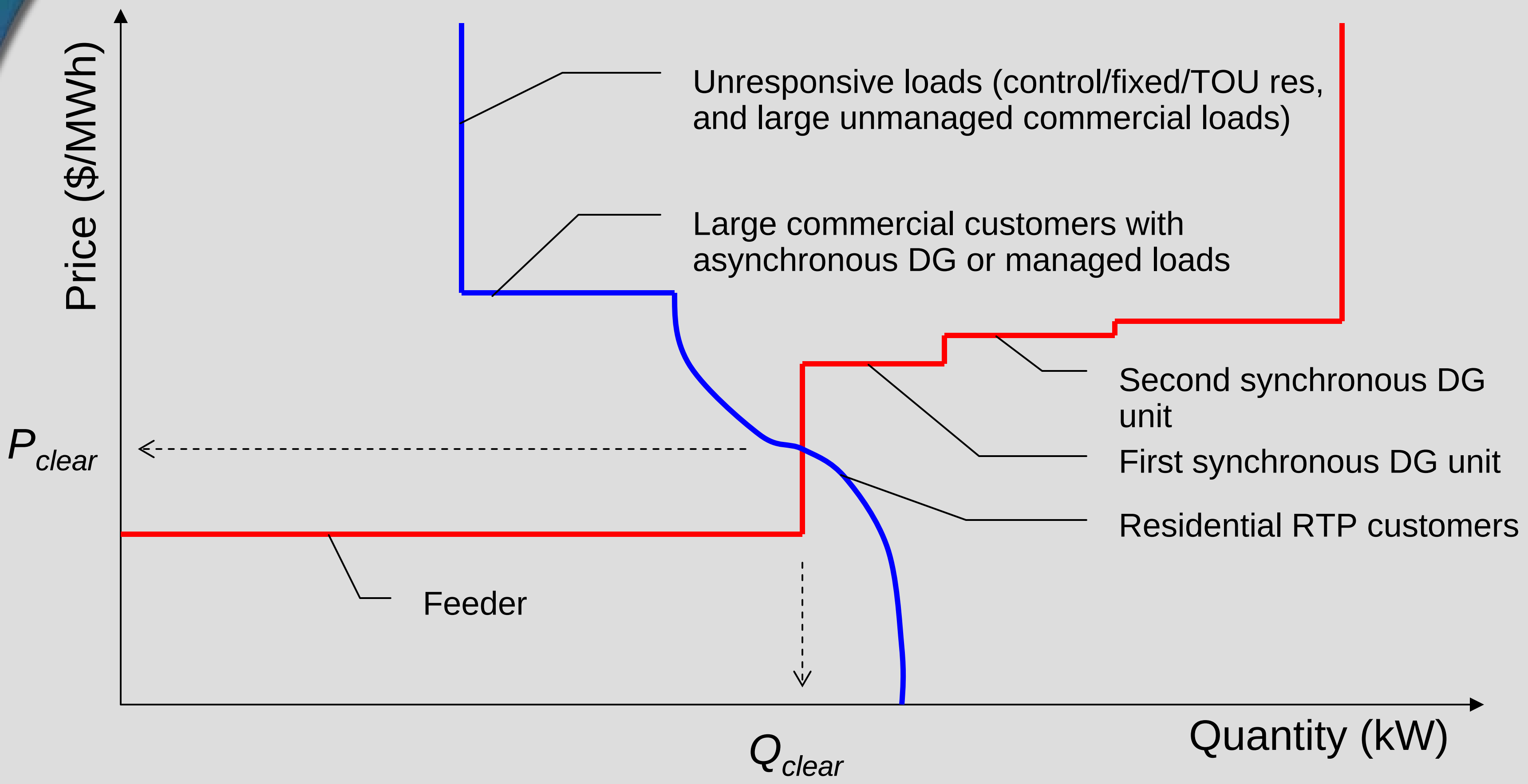
- Integrate multiple commercial and residential assets
  - Distributed Generation (DG)
    - ✓ Aggregated DG across several commercial sites
    - ✓ Individual dispatchable DG
  - Demand Response (DR)
    - ✓ Residential and Commercial Demand Response assets
    - ✓ Direct load control
    - ✓ Residential customer signals to encourage usage change

Shadow Real-Time Market

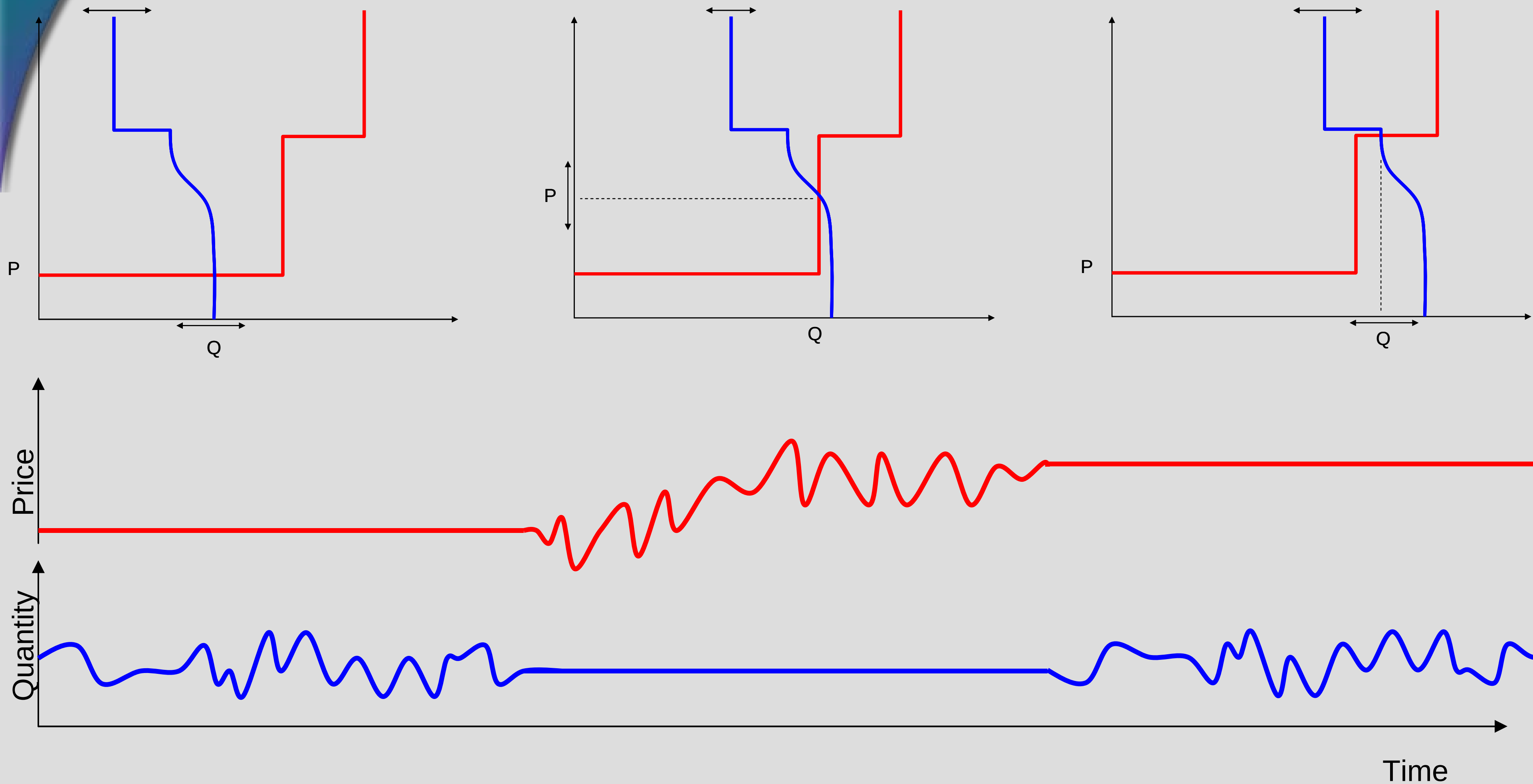
- Handled outside the normal utility energy bill; cost of energy from the market is paid for by Residential Customers with DoE-seeded funds in a managed account

- Both DR and DG assets bid into market
  - Base clearing price is calculated from the Mid-Columbia wholesale market price, adjusted based on real-time market demand and constraints

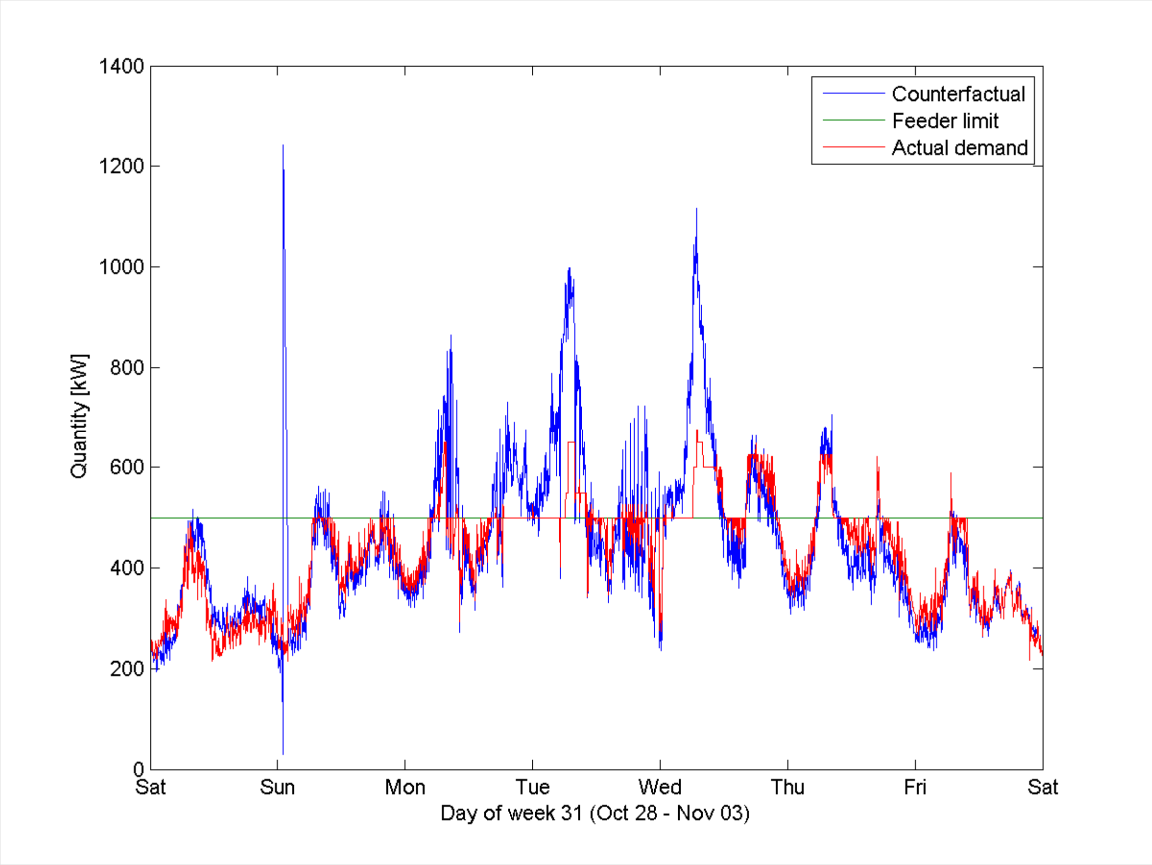
Price-based Distribution Dispatch



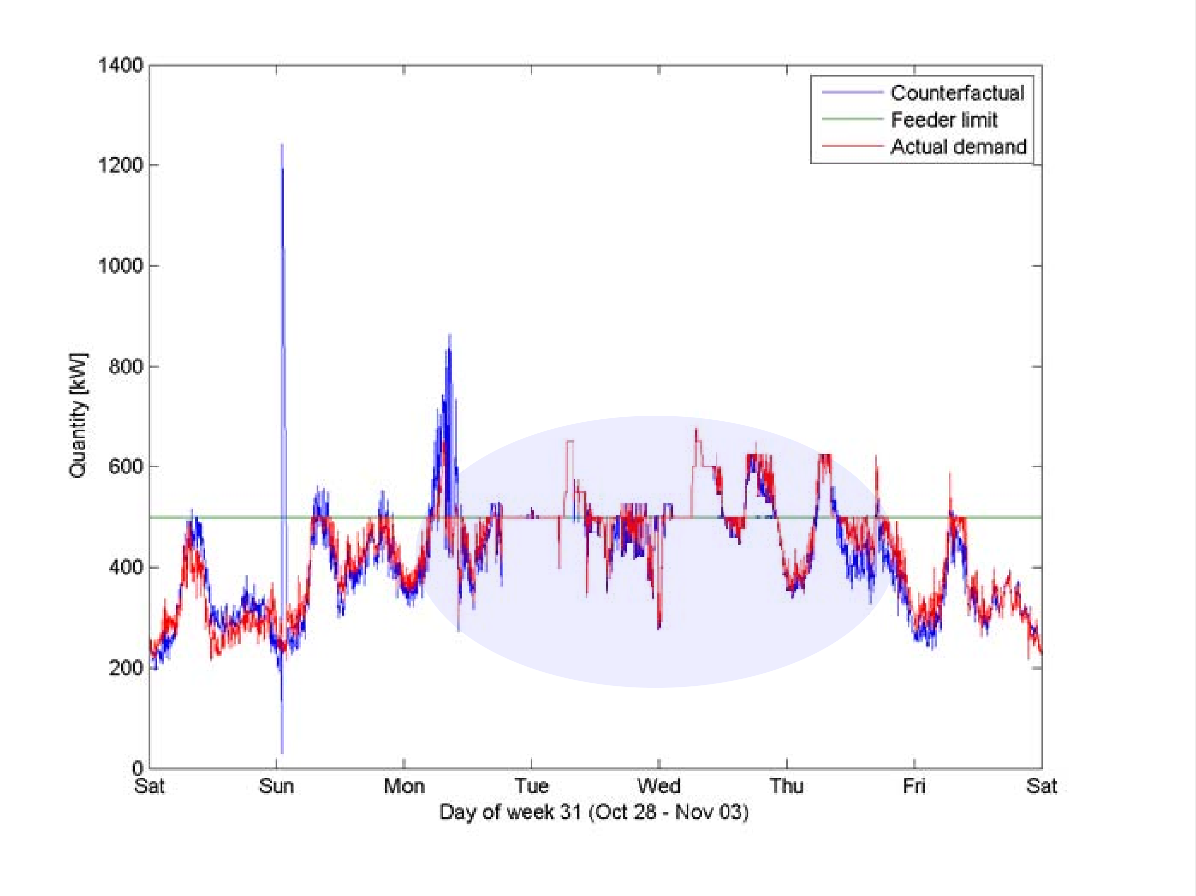
How real-time price flattens load



Feeder capacity impact
High load with good response



Feeder capacity management: Load flattening under high-load conditions

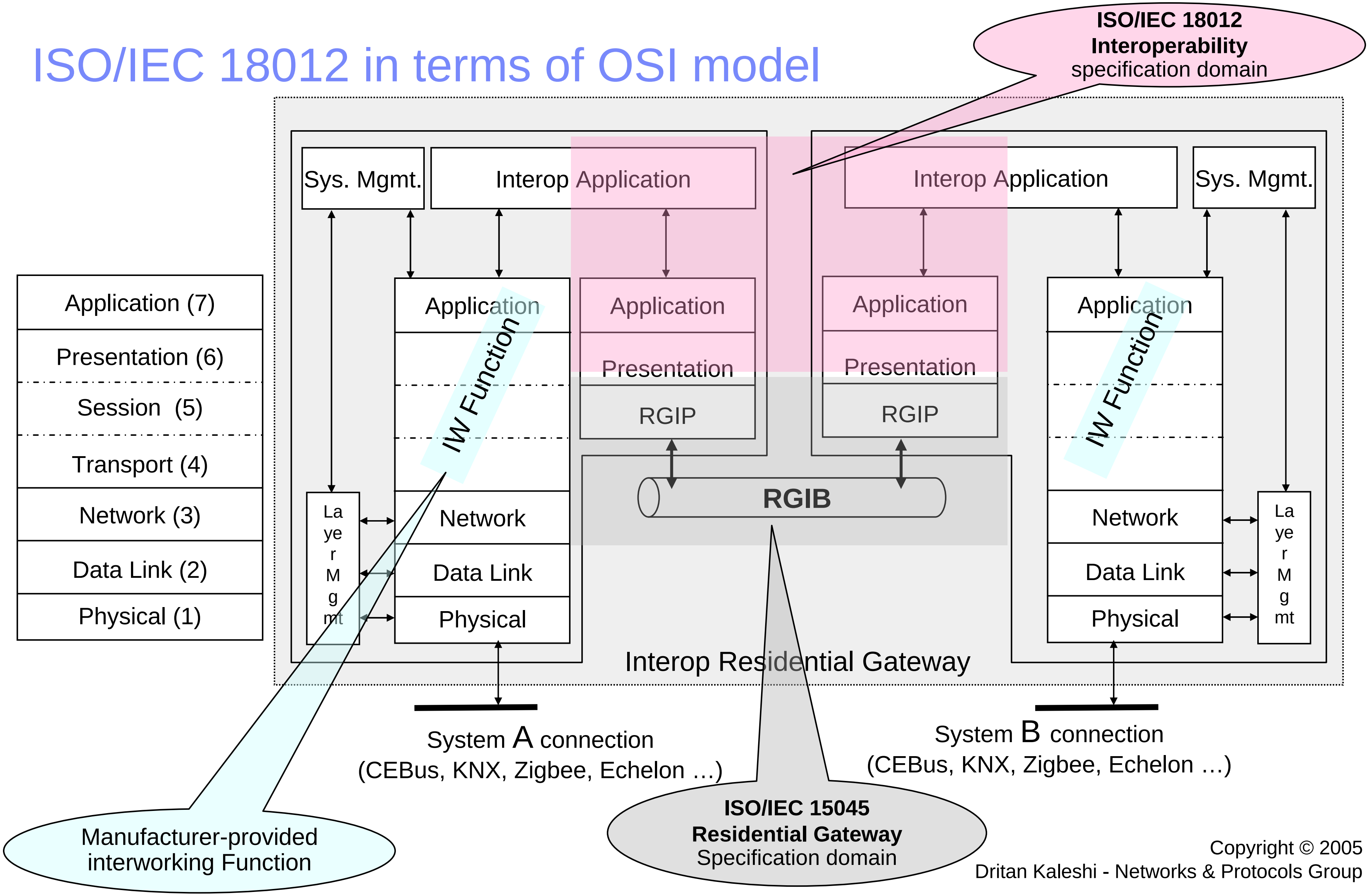


The Need for an Interoperability Framework

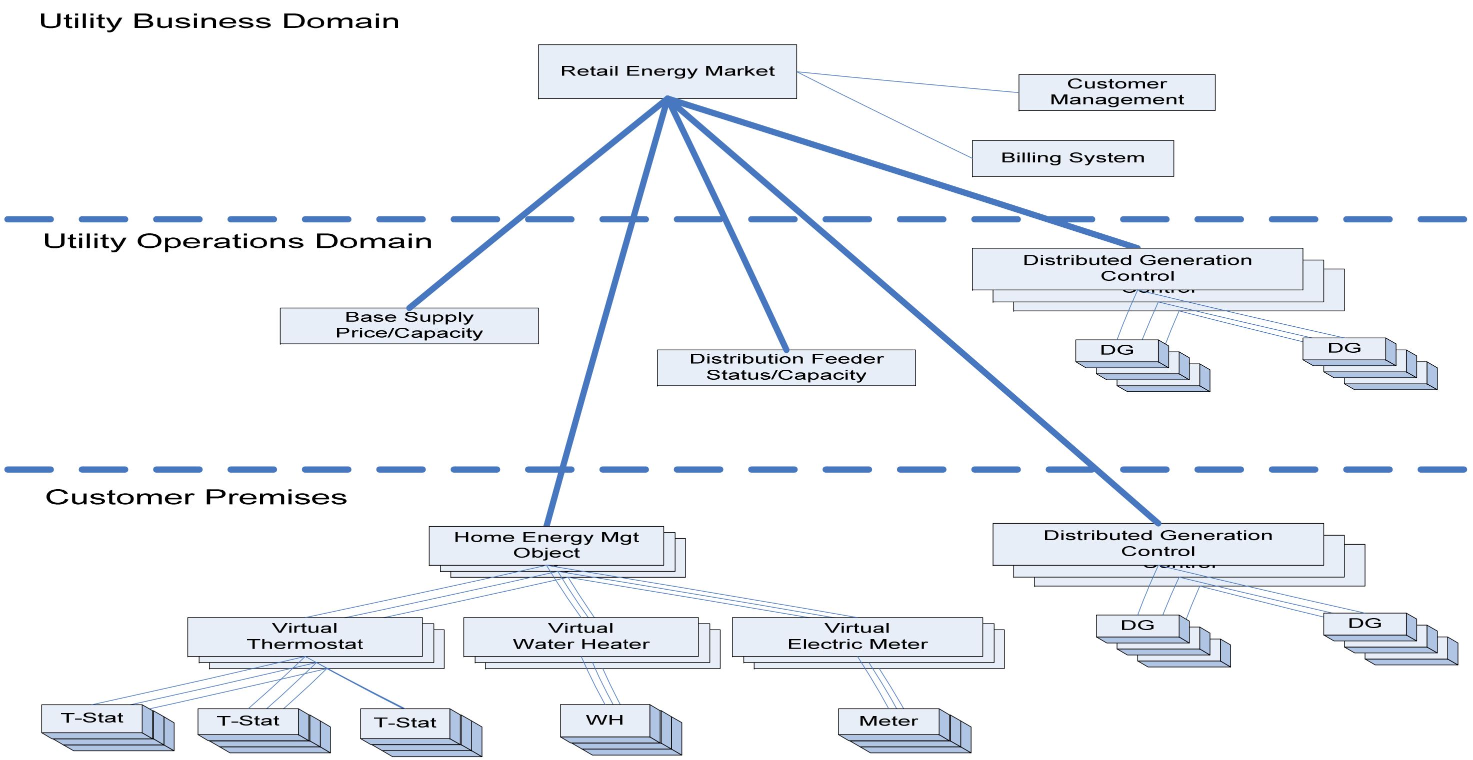
The GWAC Stack as applied in Olympic Peninsula project

Organizational	8: Economic/Regulatory Policy	We defined assumptions about the real-time market model that we wished to test
	7: Business Objectives	Defer capital investment; improve response to unplanned outages
	6: Business Procedures	Real-time market and buy/sell bids as the primary optimization mechanism
Informational	5: Business Context	Real-time Pricing accounts with customers
	4: Semantic Understanding	***Defined virtual devices that combined the physical device functions with addl business process information flow & functions***
Technical	3: Syntactic Interoperability	***Used an implementation of ISO/IEC 18012-2 to establish heterogeneous interoperability and enable semantic model above***
	2: Network Interoperability	IP and non-IP bridged by a gateway – little or no application function in the gateway
	1: Basic Connectivity	Heterogeneous mix of wired and wireless technologies

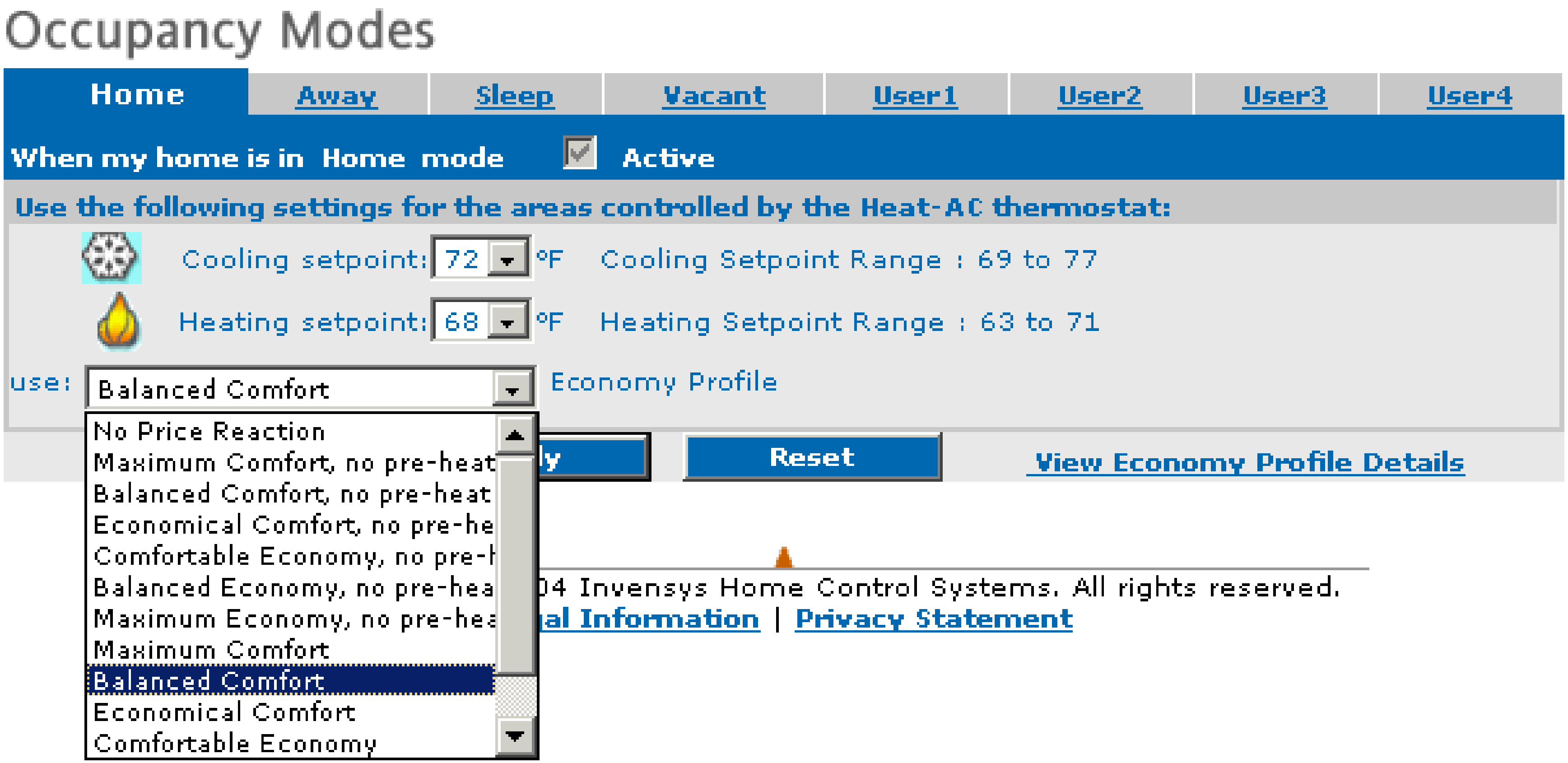
ISO/IEC 18012 in terms of OSI model



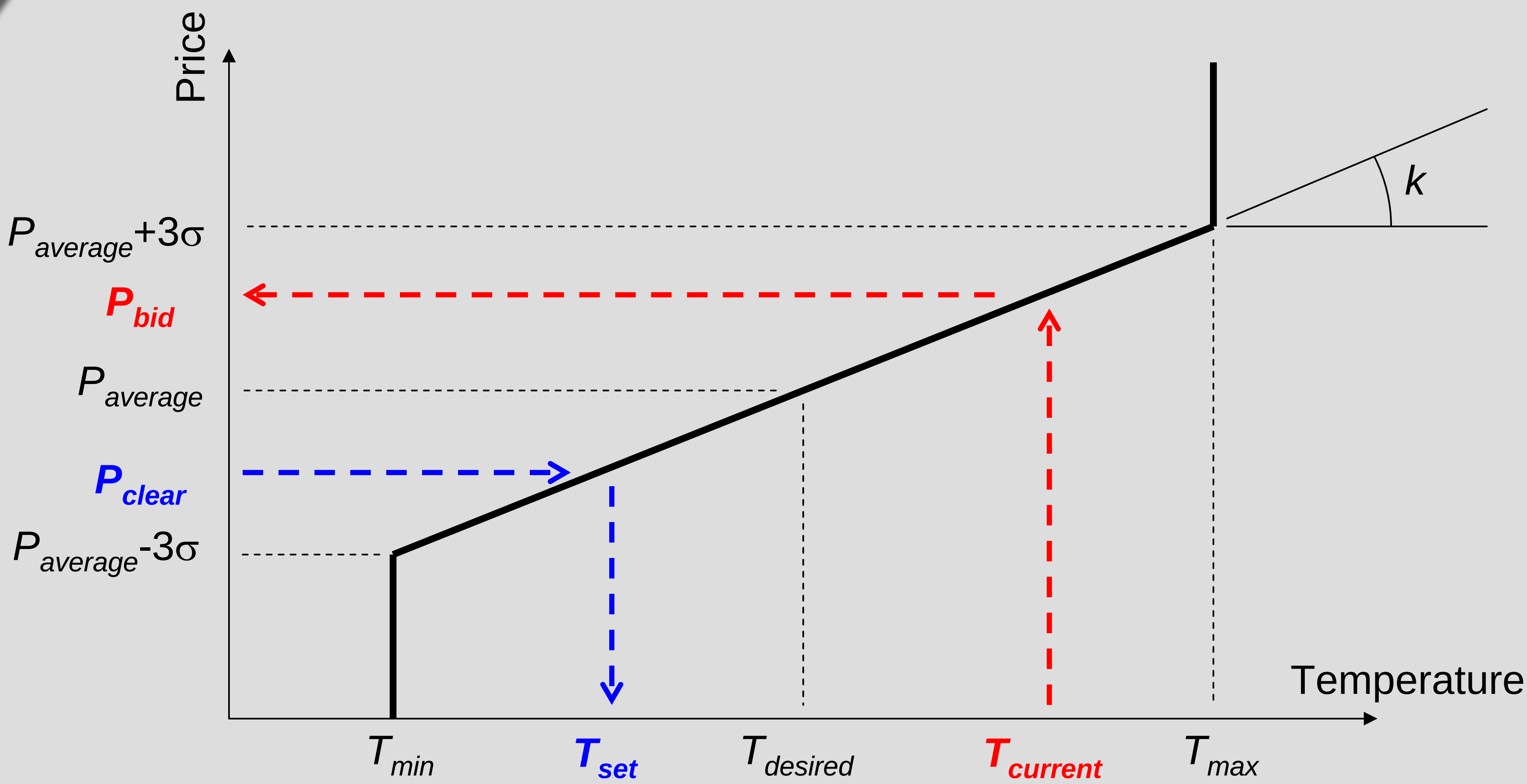
The Virtual Thermostat Object



User Goal-based Preferences



RTP Control for Thermostatic Devices



<u>Small *k*</u>: low comfort, high demand response

<u>Large *k*</u>: high comfort, low demand response

Results

- An Internet-based network coordinating DR can save consumers money on power, and reduce peak load on the grid by approximately 15% over the course of 1 year.

- A significant number of customers will sign up for and respond to a real-time price that varies on a 5-minute interval when they are provided computer-based technology that automates their response and preserves their right to choose their preference for comfort or savings.

- A combination of demand response and distributed generation reduced peak distribution loads by 50 percent for days.

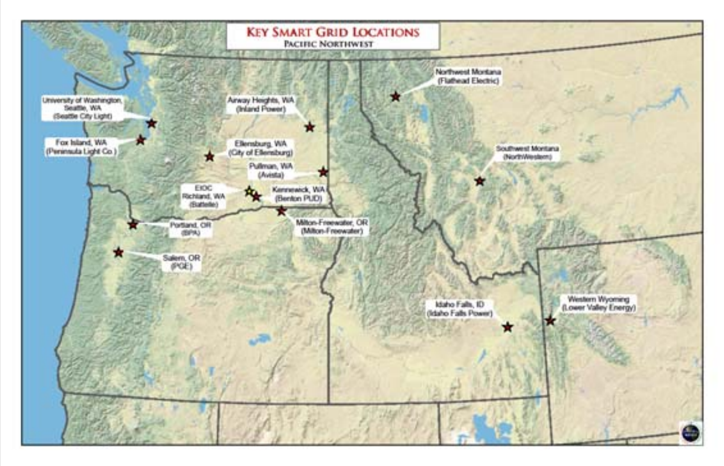
- Utility-dispatched DR can alleviate the need to build expensive new infrastructure to address constraints on the T&D system during times of peak demand.

- Successfully managed a “virtual” distribution line, or feeder, and an imposed feeder constraint for an entire year

- The technologies and approach proved technically feasible, wide-scale adoption is more limited by regulations than technical limitations.

Pacific Northwest Smart Grid Regional Demo

- Expands upon the 2006 DOE-funded Pacific Northwest Gridwise Demo project
- Spans Idaho, Montana, Oregon, Washington, and Wyoming, 12 utilities, $178M over 5 years
- Objectives:
  - Validate smart grid technologies and business models
  - Provide two-way communication between distributed generation, storage, and demand assets and the existing grid infrastructure
  - Quantify smart grid costs and benefits
  - Advance standards for interoperability and cybersecurity approaches
- Team will implement a unique distributed communication, control, and incentive system
- IBM Research team leading overall system architecture and interoperability/integration and contributing to cybersecurity, analytics (for DER), and secure messaging



Thank you