OpenADR Technology Demonstration in the Northwest

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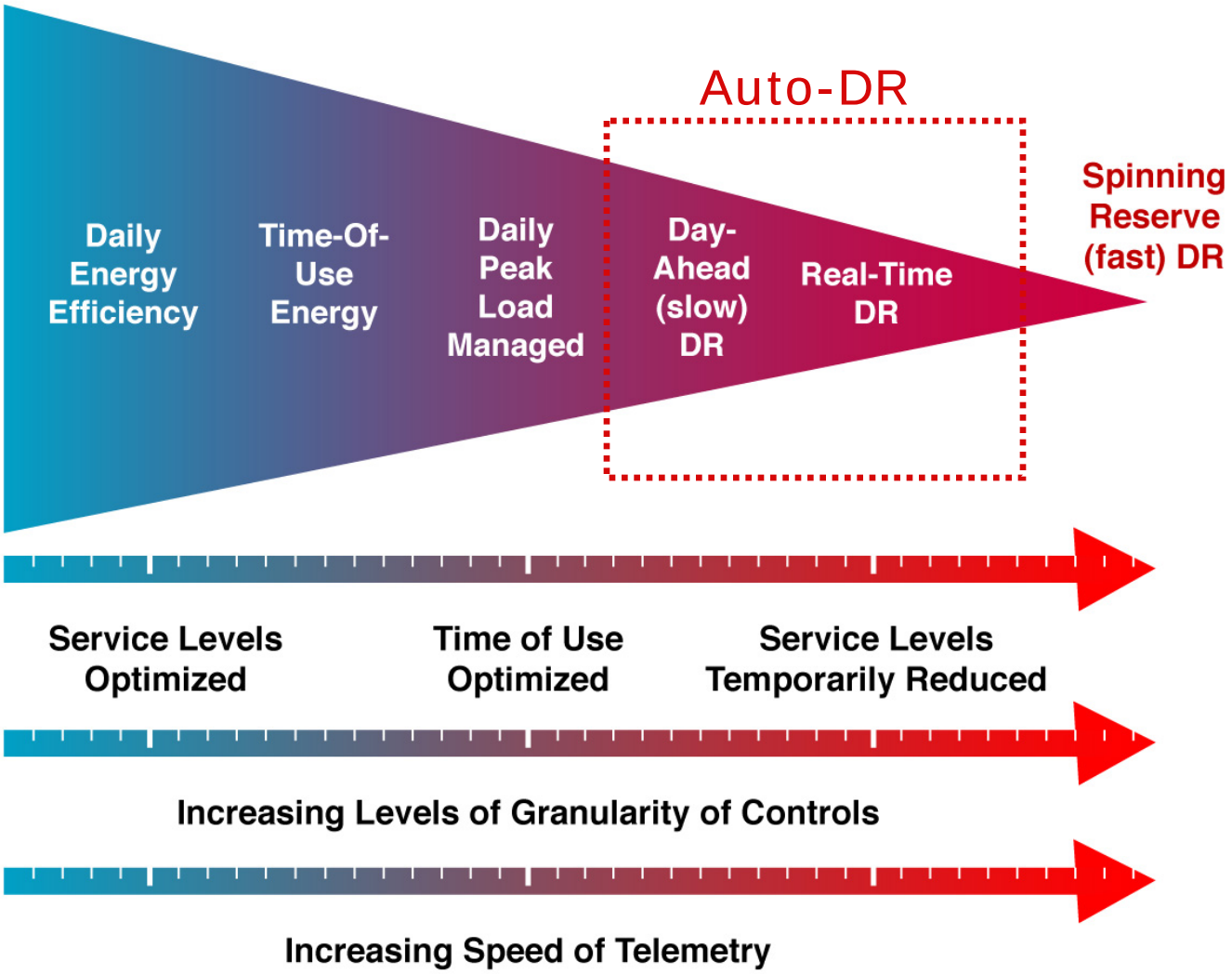
Presentation Outline

- Background
- Automation Definition and Goals
- History
- Architecture
- BPA/SCL Technology Demonstration Project
- Next Steps

Demand Response Definition

- Demand Response (DR) is the action taken to reduce load when:
  - Contingencies (emergencies & congestion) occur that threaten supply-demand balance, and/or
  - Market conditions occur that raise supply costs
- DR typically involves peak-load reductions
  - DR strategies are different from energy efficiency, i.e., transient vs. permanent

Time Scales of Building/Grid Optimization – Automated DR Future



Demand Response Options

- Reliability programs (utility operated)
  - Air conditioning cycling
  - Interruptible/curtailment
- Economic programs (customer choice)
  - Demand bidding
  - Demand reserves
- Signals (price and emergency)
  - Automatic demand response

Automation Goals and Definition

Recent Research Goals

- **Cost** - Develop low-cost, automation infrastructure to improve DR capability in California
- **Technology** - Evaluate "readiness" of commercial buildings to receive signals
- **Capability** - Evaluate capability of control strategies for current and future buildings

Auto-DR Definition - Fully automated signals for end-use control

- **Signaling** – Continuous, secure, reliable, 2-way comm; listen and acknowledge
- **Industry Standards** - Open, interoperable communications to integrate with both common EMCS and other end-use devices that can receive a relay or similar signals (such XML)
- **Timing of Notification** - Day ahead and day of signals facilitate diverse strategies

Auto-DR Multi-Year Technology Development Summary

- Develop Demand Response Automation Server (annually updated)
- Develop connection to Energy Management Control Systems (EMCS)
- Field Tests – Recruit sites/ 2 to 12 events per summer
  - 2003 – Demo with 5 sites – Internet link to Energy Information Systems (EIS)
  - 2004 - Demo with 18 sites - linked to EIS and EMCS
  - 2005 – Initlal PG&E collaboration
  - 2006 - PG&E, SDG&E, Planning with SCE
  - 2007 - PG&E, SCE, and SDG&E
  - 2008 - PG&E, SCE, and SDG&E SDG&E
  - 2009 - Same California programs
    - Bonneville Power Administration/ Seattle City Light,
    - Participating Load Pilot Wholesale DR w/ PG&E
- Evaluate with weather normalized baseline

Year	# of Sites	DRAS	Site Communications	Utility
2003	5	Infotility	XML Gateway Software	None
2004	18	Infotility	XML - Internet Relay	None
2005	11	Akuacom	XML - Internet Relay	PG&E
2006	25	Akuacom	XML - CLIR	PG&E, SDG&E
2007-08	200+	Akuacom	XML - CLIR	Statewide

SCL / BPA Project

Goal - to demonstrate technology and understand DR opportunities in the Northwest with realistic customer interactions

- How easy to automate?
- What are control strategies for cold winter mornings?
- How large are reductions from these strategies (kW, W/sqft, %)?

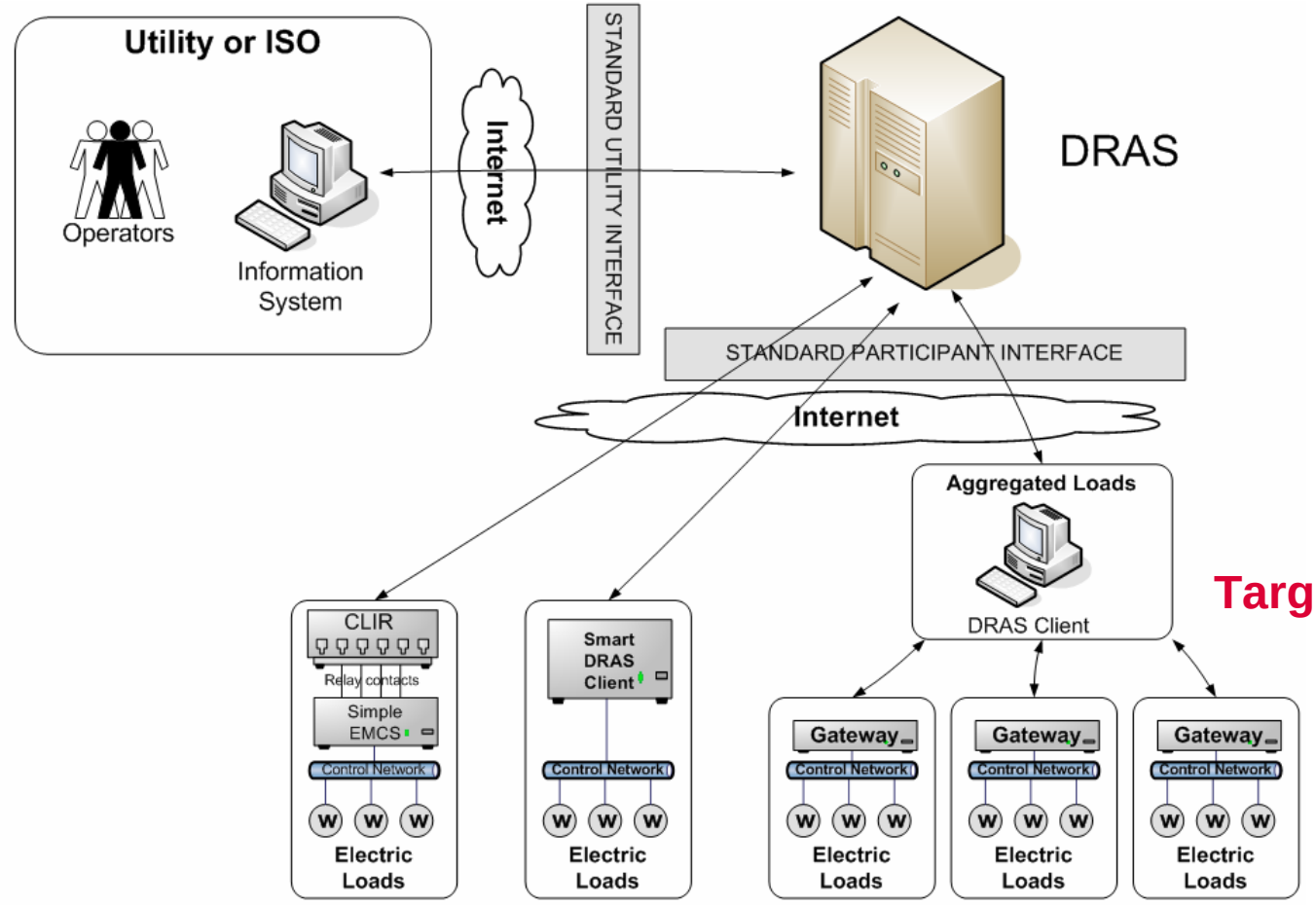
Co-sponsored technology demonstration

- OpenADR technology from Lawrence Berkeley National Laboratory
- First time outside of California and in a heating climate

Implementation

- Install and configure technology
- Design shed strategies for each customer
- *Practice* strategies
- Measure impacts (metering, surveys)

Demand Response Automation Architecture



Target

Seattle University
Seattle Municipal Tower

McKinstry

DR Control Strategies (and previous examples)

	HVAC								Lighting					Other		
Site	Global temp. adjustment	Duct static pres. Decrease	SAT Decrease	Fan VFD limit	RTU Shut off	Duty Cycling	Pre-heating	Fan-coil unit off	Common area light dim	Office area light dim	Turn off light	Dimmable ballast	Bi-level switching	Non-critical process shed	Elevator cycling	Water pump peak shift
McKinstry						X										
Target - T1284	X				X								X			
Target - T0637	X				X								X			
Seattle Municiple Tower	X															
Seattle University	X					X	X									

Technology Demonstration Sites

Site	Site Address	Building Type	Gross Floor Area ft²	Year Constructed	Peak Load kW	Peak W/ft²
McKinstry	5005 3rd Avenue S	Office	100,000		347	**3.5**
Target - T1284*	302 NE Northgate Way	Retail	165,667	2000	685	**4.1**
Target - T0637*	2800 SW Barton St.	Retail	99,471	1990	225	**2.3**
Seattle Municipal Tower	700 Fifth Avenue	Office	1,200,000	1989	6168	**5.1**
Seattle University	901 12th Avenue	Education	99,840	2001	841 kVA	**8.4**

	18-Feb	25-Feb	3-Mar	5-Mar	9-Mar	10-Mar	11-Mar	12-Mar	16-Mar	18-Mar	20-Mar
Site	**Test 1**	**Test 2**	**Test 4**	**Test 5**	**Test 6**	**Test 7**	**Test 8**	**Test 9**	**Test 10**	**Test 11**	**Test 12**
McKinstry Seattle	Day Ahead	Day Ahead		Day-Of			Day Ahead				
Target - T1284			Day Ahead	Day-Of	Day Ahead		Day Ahead				
Target - T0637							Day Ahead		Day-Of	Day Ahead	Day Ahead
Seattle Municipal Tower			Day Ahead	Day-Of	Day Ahead		Day Ahead				
Seattle Univ.						Day Ahead		Day Ahead	Day-Of	Day Ahead	

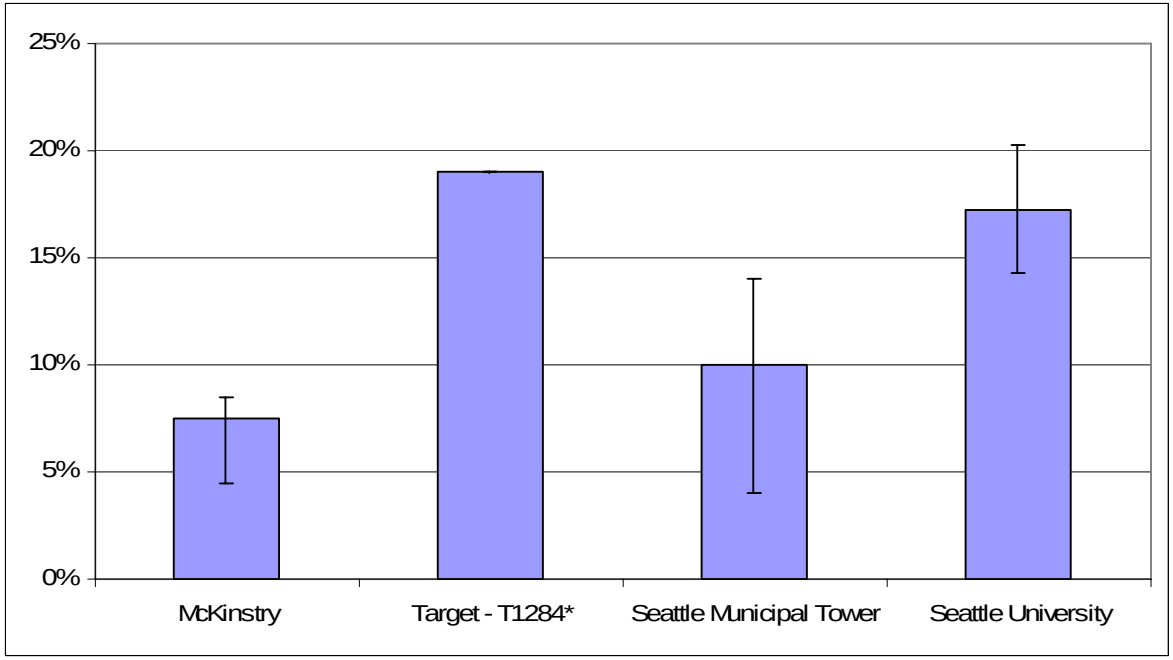
DR Test Events

	18-Feb	25-Feb	3-Mar	5-Mar	9-Mar	10-Mar	11-Mar	12-Mar	16-Mar	18-Mar	20-Mar
Site	**Test 1**	**Test 2**	**Test 4**	**Test 5**	**Test 6**	**Test 7**	**Test 8**	**Test 9**	**Test 10**	**Test 11**	**Test 12**
McKinstry Seattle	Day Ahead	Day Ahead		Day-Of			Day Ahead				
Target - T1284			Day Ahead	Day-Of	Day Ahead		Day Ahead				
Target - T0637							Day Ahead		Day-Of	Day Ahead	Day Ahead
Seattle Municipal Tower			Day Ahead	Day-Of	Day Ahead		Day Ahead				
Seattle Univ.						Day Ahead		Day Ahead	Day-Of	Day Ahead	

Baselines

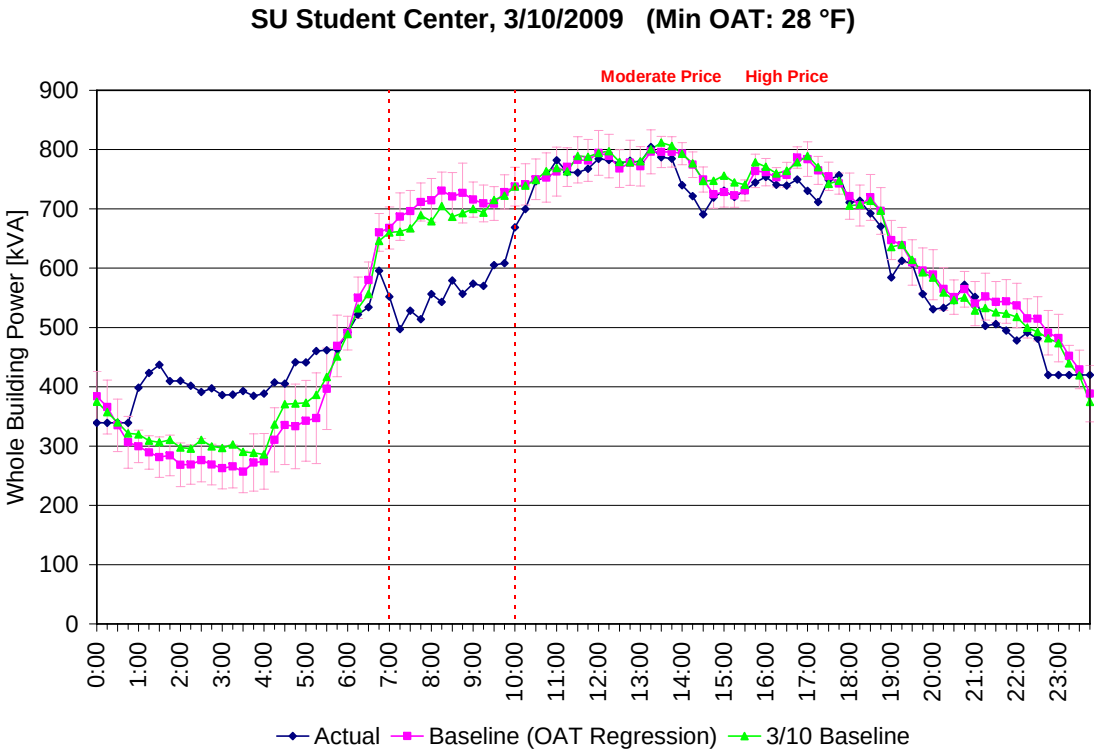
- 3/10: Average of the three highest energy consuming business days (within the DR period) within the last ten days
- OAT Regression: Outside air regression with 10 business day demand data.
- Average load: For two sites without any historical data, averaged the 15-min. load data for available business days.

Demand Savings Results



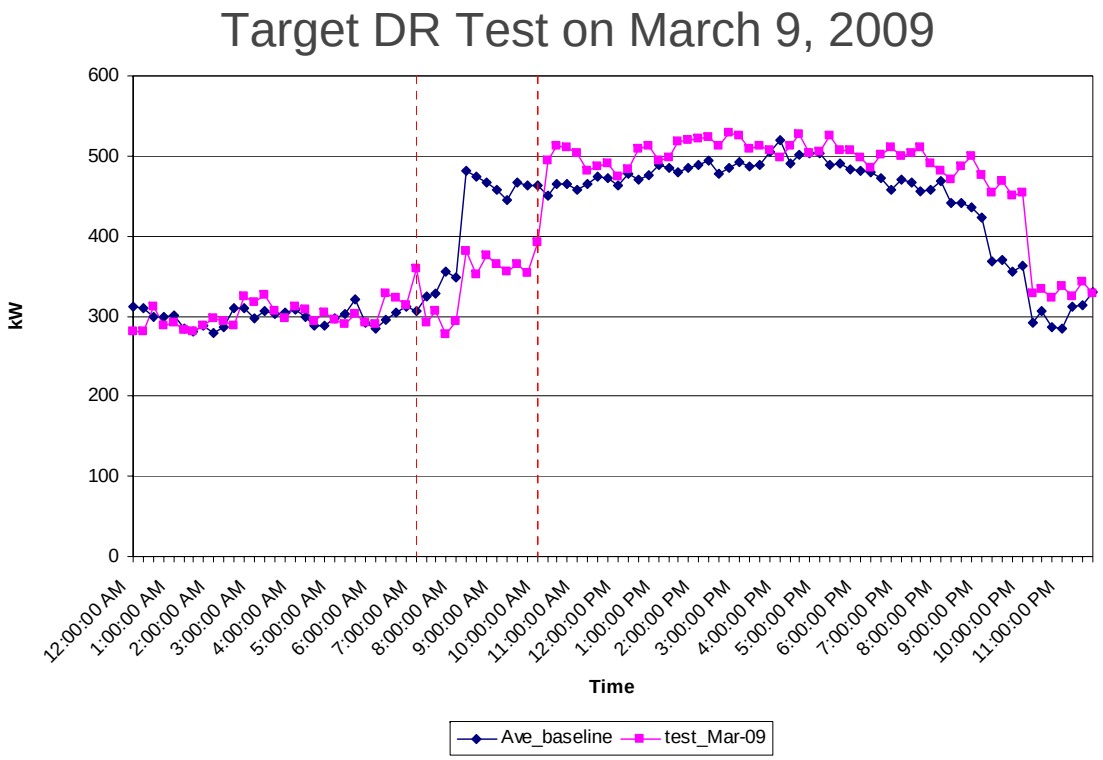
Site	Savings	Test 1	Test 2	Test 3	Test 4	Average
McKinstry	kW	26	24	14	25	**22**
	WBP%	8%	8%	5%	9%	**8%**
Target - T1284*	kW	102		104		**103**
	WBP%	19%		19%		**19%**
Seattle Municipal	kW	678	696	220	438	**508**
	WBP%	14%	14%	4%	8%	**10%**
Seattle University	kW	149	94	121	107	**118**
	WBP%	21%	14%	18%	16%	**17%**

Demand Profiles from Test Events



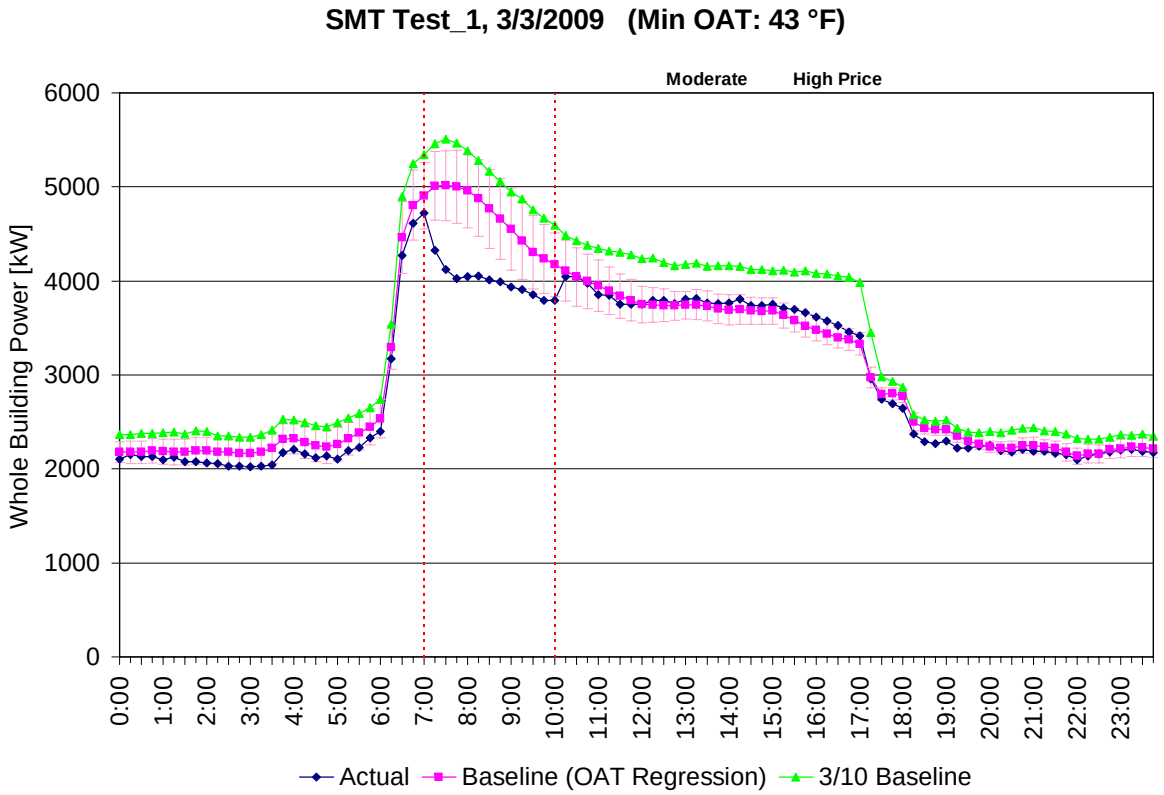
OAT Baseline	kW		W/sqft		WBP%	
	Max	Ave	Max	Ave	Max	Ave
7:00-8:00	198	178	1.98	1.78	28%	25%
8:00-9:00	188	160	1.88	1.60	26%	22%
9:00-10:00	139	108	1.39	1.08	20%	15%

Demand Profiles from Test Events



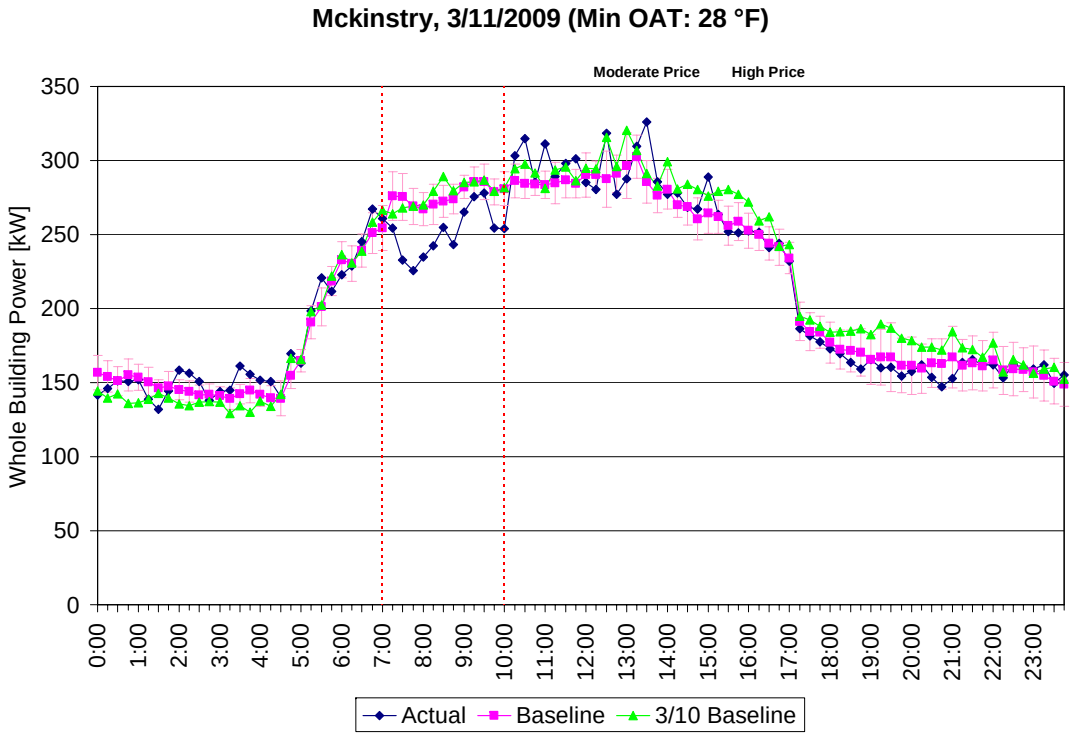
Date	Baseline	kW		W/sqft		WBP%	
		Max	Ave	Max	Ave	Max	Ave
Mar-09	7:00-8:00	80	47	0.48	0.29	22%	14%
	8:00-9:00	122	101	0.74	0.61	26%	22%
	9:00-10:00	109	93	0.66	0.56	24%	20%

Demand Profiles from Test Events



Date	OAT Baseline	kW		W/sqft		WBP%	
		Max	Ave	Max	Ave	Max	Ave
Mar-03	7:00-8:00	973	867	9.73	8.67	19%	17%
	8:00-9:00	827	716	8.27	7.16	17%	15%
	9:00-10:00	525	450	5.25	4.50	12%	10%

Demand Profiles from Test Events



Date	Period	kW		W/ft²		WBP%	
		Max	Ave	Max	Ave	Max	Ave
Mar-11	7:00-8:00	44	35	0.44	0.35	16%	13%
	8:00-9:00	31	23	0.31	0.23	11%	9%
	9:00-10:00	27	17	0.27	0.17	10%	6%

Lesson's Learned

- Recruiting, communication with vendors, enablement are slow especially without previous DR culture/knowledge.
- Winter HVAC demand reduction opportunities in buildings with gas heating is limited.
- Lighting delivers year-round DR.
- Baseline methods have to be developed.

Next Steps

- Test summer DR strategies with the same sites.
- Enhance DRAS capabilities to dispatch targeted DR events
- Expand tests to other utilities.
- Train and educate control vendors, facility managers, building owners.
- Work with standards development organizations to move OpenADR specifications into formal standards.

Features of Open Automated DR Communications (OpenADR) Specification

- Continuous and Reliable - Provides continuous, secure, and reliable 2 communications infrastructure
- Translation - Translates DR event information to continuous internet signals
- Automation - Receipt of the signal is designed to initiate automation
- Opt-Out - Provides opt-out or override function
- Complete Data Model – Describes model and architecture to communicate price, reliability, and other DR activation signals.
- Scalable – Provides communications architecture scalable to many forms of DR programs and tariffs

http://www.openadr.org/

OpenADR Adoption - Collaborative Activities

- Centralized development and documentation of information concerning OpenADR deployments.
- Education and training sessions to support control vendors, system integrators and facilities.
- Co-development of marketing strategies between Utilities/ISO's and vendors for specific DR programs.
- Development of an OpenADR marketing portal targeted toward customers that may be interested in participating in an automated DR program.
- Compliance testing, including the possibility of branding.

Auto-DR Client Development

Vendor	Sector	End-Use	Client Dev
PowerIT	Industrial	Refrigeration	Completed
Cassatt Corp	Industrial	Data Center Servers	Completed
Adura Technologies	Commercial	Lighting	Completed
LumEnergi	Commercial	Lighting	Completed
Automated Logic Corp	Commercial	HVAC	Completed
Federspiel Controls	Commercial/Industrial	HVAC	Completed
Universal Devices	Commercial/Residential	HVAC/Lighting/Others	Completed
Richards Zeta	Commercial	HVAC/Lighting	Completed
Invensys/Wonderware	Industrial	SCADA/HMI	Completed
Eaton	Commercial	Lighting	Completed
Tendril	Residential	HVAC/Others	Completed
Cypress Systems	Commercial/Industrial	HVAC/Others	Completed
BPL Global	Commercial/Residential	HVAC/Others	In process
Honeywell	Commercial	HVAC/Others	In discussion
Red Dwarf Technologies	NA	NA	In discussion
Convergence Wireless	Commercial	Lighting	In discussion
Beckhoff	Commercial	Lighting	In discussion
Wattstopper	Commercial	Lighting	In discussion
The list below is from Akuacom			
Daikin Industries Ltd	Commercial/Industrial	HVAC	NA
e-radio USA	Technology Integrator	RDS/FM, etc	NA
Emacx Systems	NA	NA	NA
Energy ICT	Technology Integrator	Automation Systems	NA
Lynxspring	Technology Integrator	Automation Systems	NA
Regen Energy	Technology Integrator	HVAC/Lighting/Others	NA
RTP Controls	Technology Integrator	Automation Systems	Completed
Advanced Telemetry	Technology Integrator	Automation Systems	Completed
Echelon	Technology Integrator	Automation Systems	Completed
KW Aware	Technology Integrator	Automation Systems	Completed
Site Controls	Technology Integrator	Automation Systems	Completed
Advantech	Technology Integrator	Automation Systems	Completed
Stonewater	Technology Integrator	Automation Systems	Completed

Thank you

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http://drrc.lbl.gov