

The Open ADR Communication System

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Integration of Renewable and Distributed Energy Resources

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DR Research Center Topics

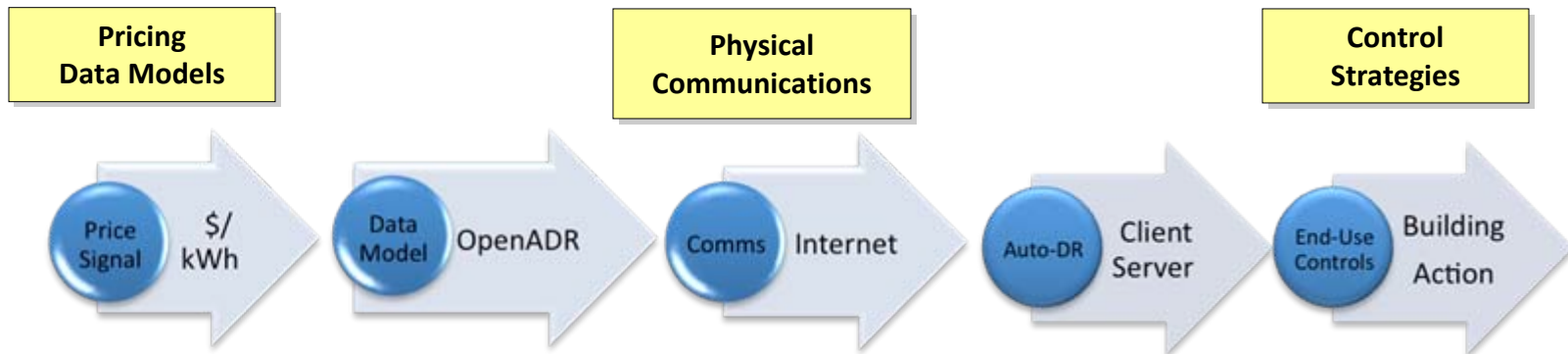
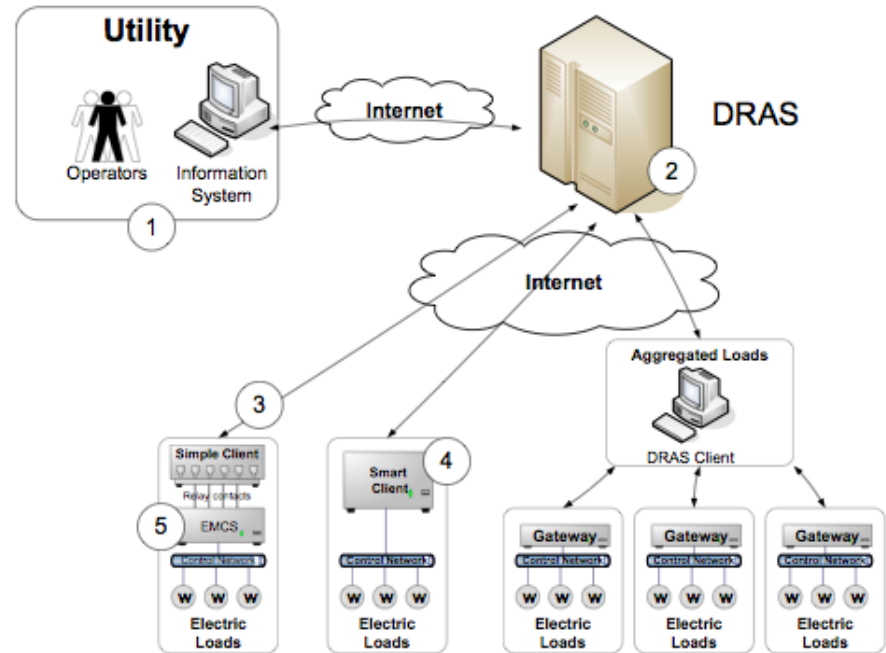
- **Energy Systems Integration and Strategic Issues**
 - Valuing Demand Response
 - Dynamic Tariffs and Rate Design
 - *Communications Infrastructure*
- **Buildings**
 - *Automation, Communications and Control*
 - *End-Use Control Strategies and Models*
 - Behavior –response to dynamic tariffs
- **Industry**
 - Automation, End-Uses and Controls

OpenADR Technology Concepts

- **2002**- Initial Research Concept
- **April 2009** – OpenADR Spec Published
- **May 2009** - one of 1st 16 NIST Smart Grid Standards
- **2010** – OpenADR in over 250 facilities in California, over 150 MW planned

Elements -

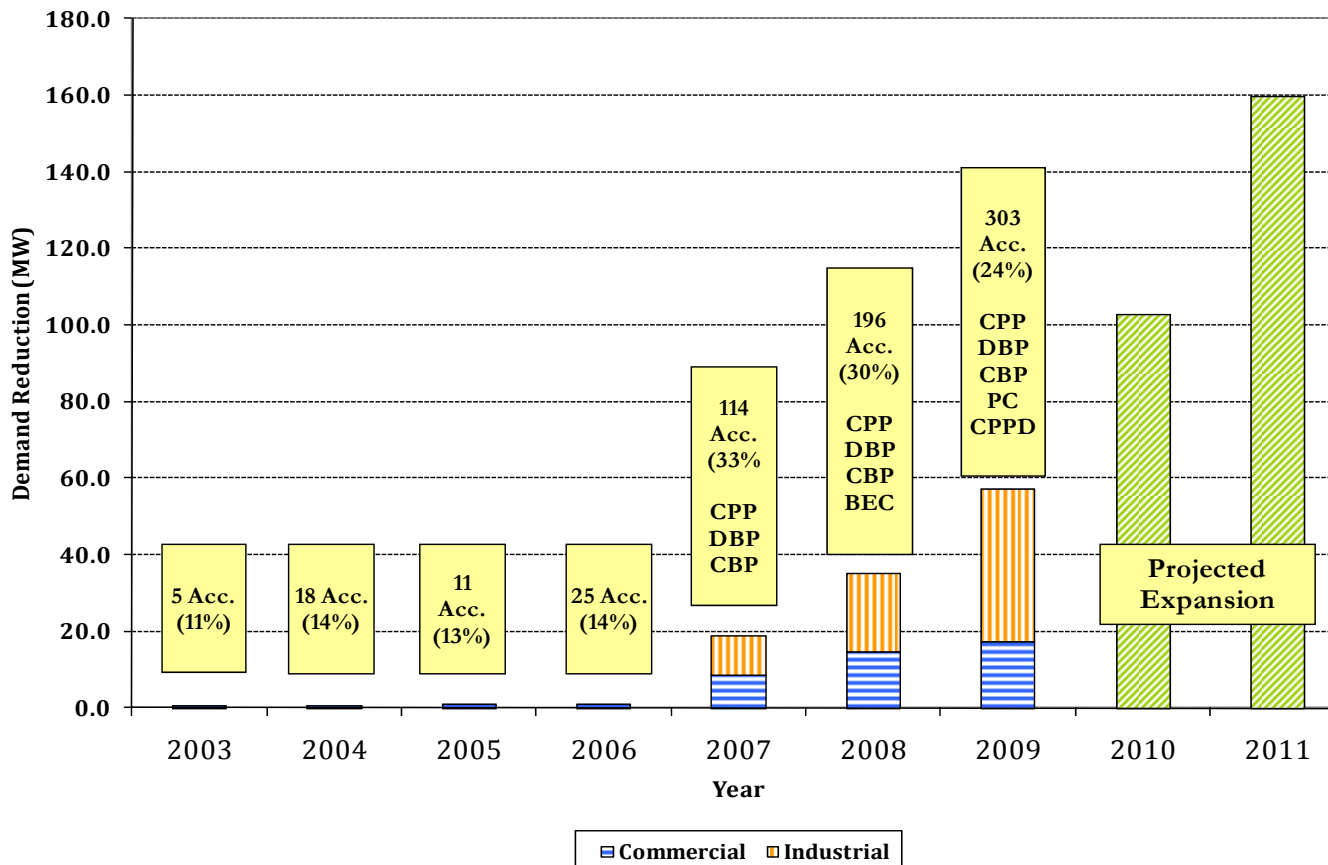
- 1 Utility System**
- 2 DR Automation Server**
- 3 Two Way Signals to Facility**
- 4 Facility Controls**
- 5 Client Acknowledges Signal**



OpenADR - Applications

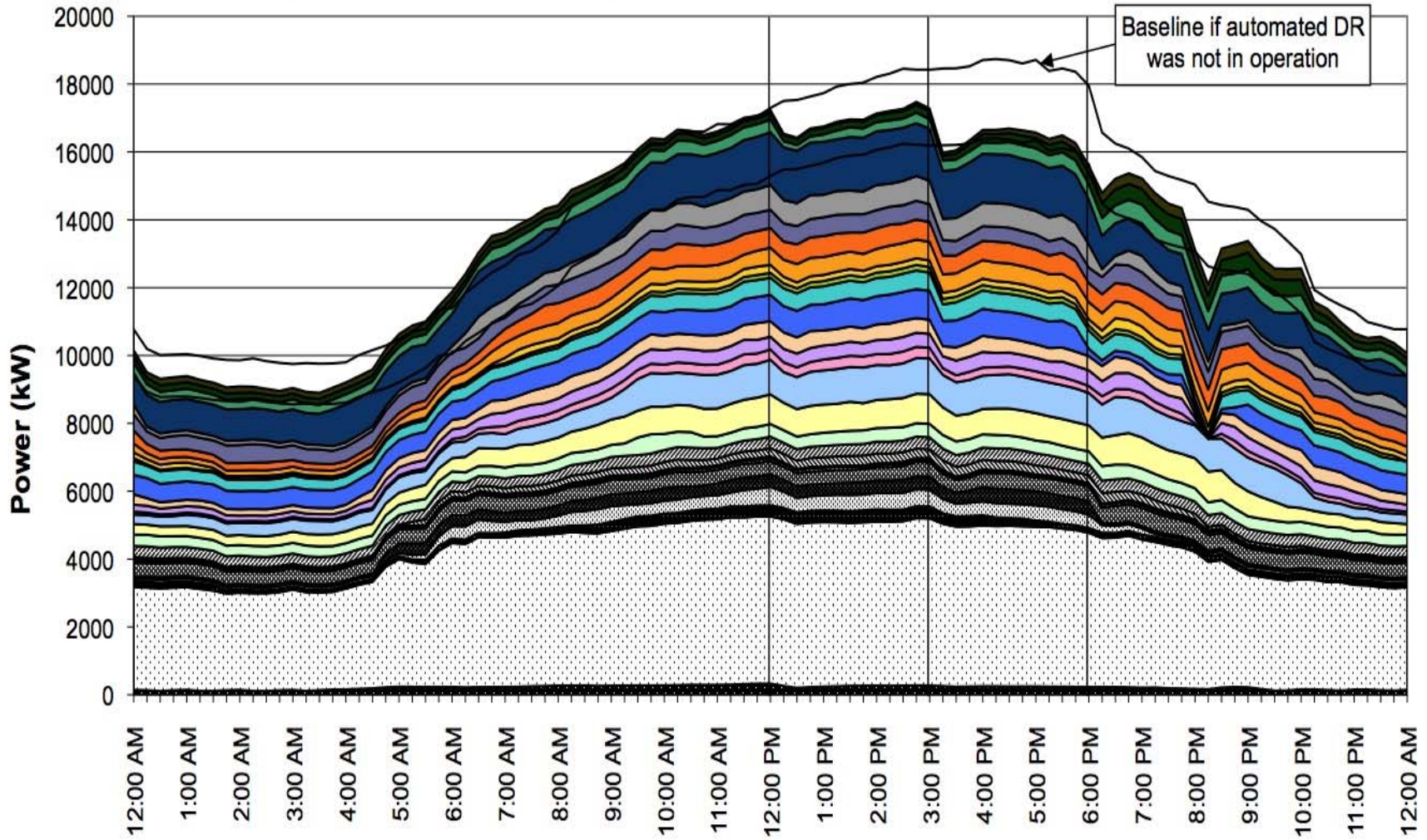


- **Large Commercial and Industrial Demand Response**
(Demand Bid, Capacity Bid, Peak Choice, Participating Load)
- **Price Response Notification and Automation**
(Retail: Critical Peak Pricing)

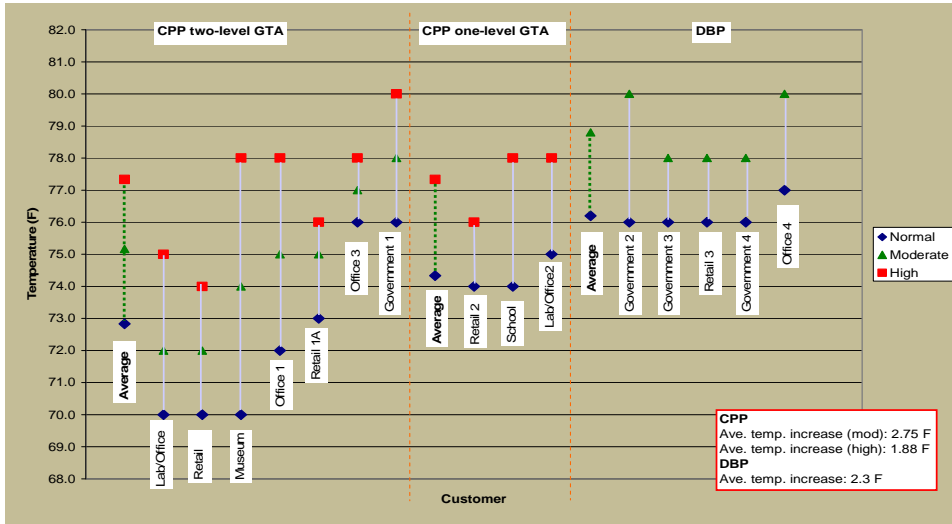


Aggregate Customer Loads for the Automated Critical Peak Pricing Event on 7/9/2008

Fully Automated Demand Response Reduce Peak Demand by 2.2 MW

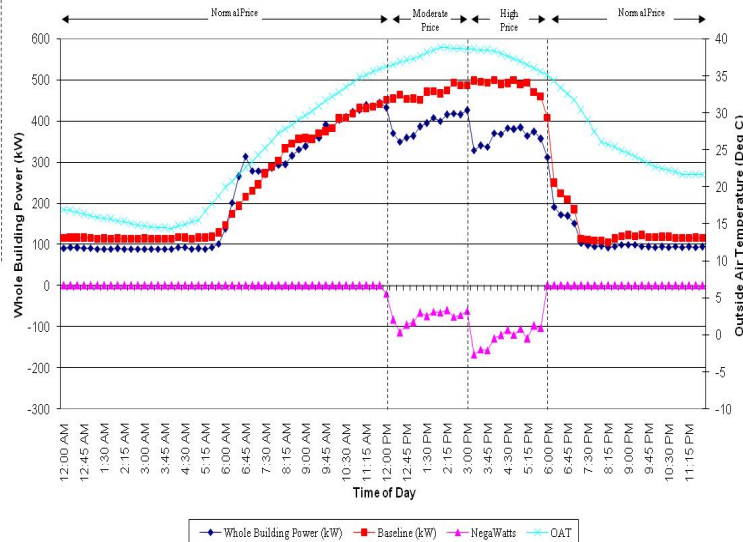


DR Control Strategies Evaluated in Previous Research



Building use	HVAC										Lighting				Other		
	Global temp. adjustment	Duct static pres. Increase	SAT Increase	Fan VFD limit	CHW temp. Increase	Fan qty. reduction	Pre-cooling	Cooling valve limit	Boiler lockout	Slow recovery	Extended shed period	Common area light dim	Office area light dim	Turn off light	Dim mable ballast	Bi-level switching	Non-critical process shed
ACWD	Office, lab	X	X	X		X		X	X	X							
B of A	Office, data center		X	X	X	X		X									
Chabot	Museum	X					X										
2530 Arnold	Office	X								X							
50 Douglas	Office	X								X							
MDF	Detention facility	X															
Echelon	Hi-tech office	X	X	X		X					X	X	X	X			
Centerville	Junior Highschool	X					X										
Irvington	Highschool	X					X										
Gilead 300	Office			X													
Gilead 342	Office, Lab	X		X													
Gilead 357	Office, Lab	X		X													
IKEA EPaloAlto	Furniture retail	X															
IKEA Emeryville	Furniture retail	X															
IKEA WSacto	Furniture retail																
Oracle Rocklin	Office	X	X														
Safeway Stockton	Supermarket																X
Solectron	Office, Manufacture	X											X				
Svenhard's	Bakery																X
Sybase	Hi-tech office											X					
Target Antioch	Retail	X				X											
Target Bakersfield	Retail	X				X											
Target Hayward	Retail	X				X					X					X	
Walmart Fresno	Retail	X														X	

Martinez, CA Office Building Electricity Use with and without AutoDR
June 21, 2006

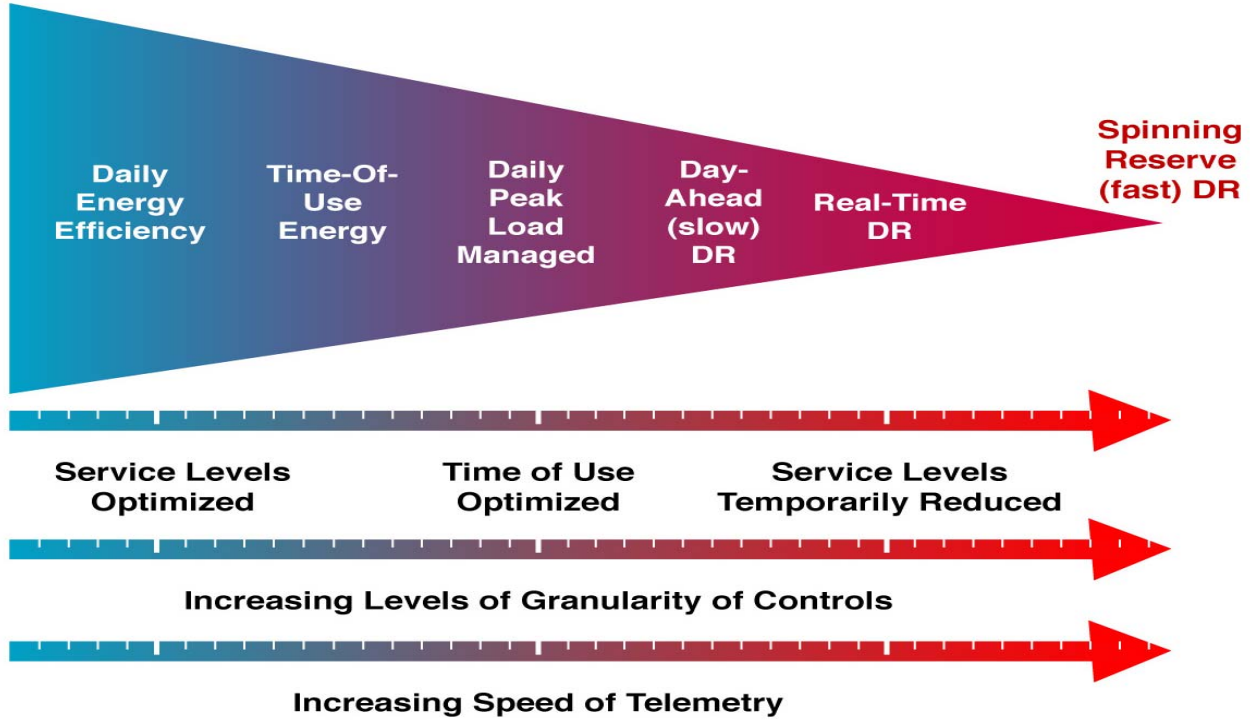


Over 50 Vendors Have OpenADR Client Over 250 Commercial and Industrial Facilities



Akuacom OpenADR Client Development Program

Linking Efficiency, DR and Renewables

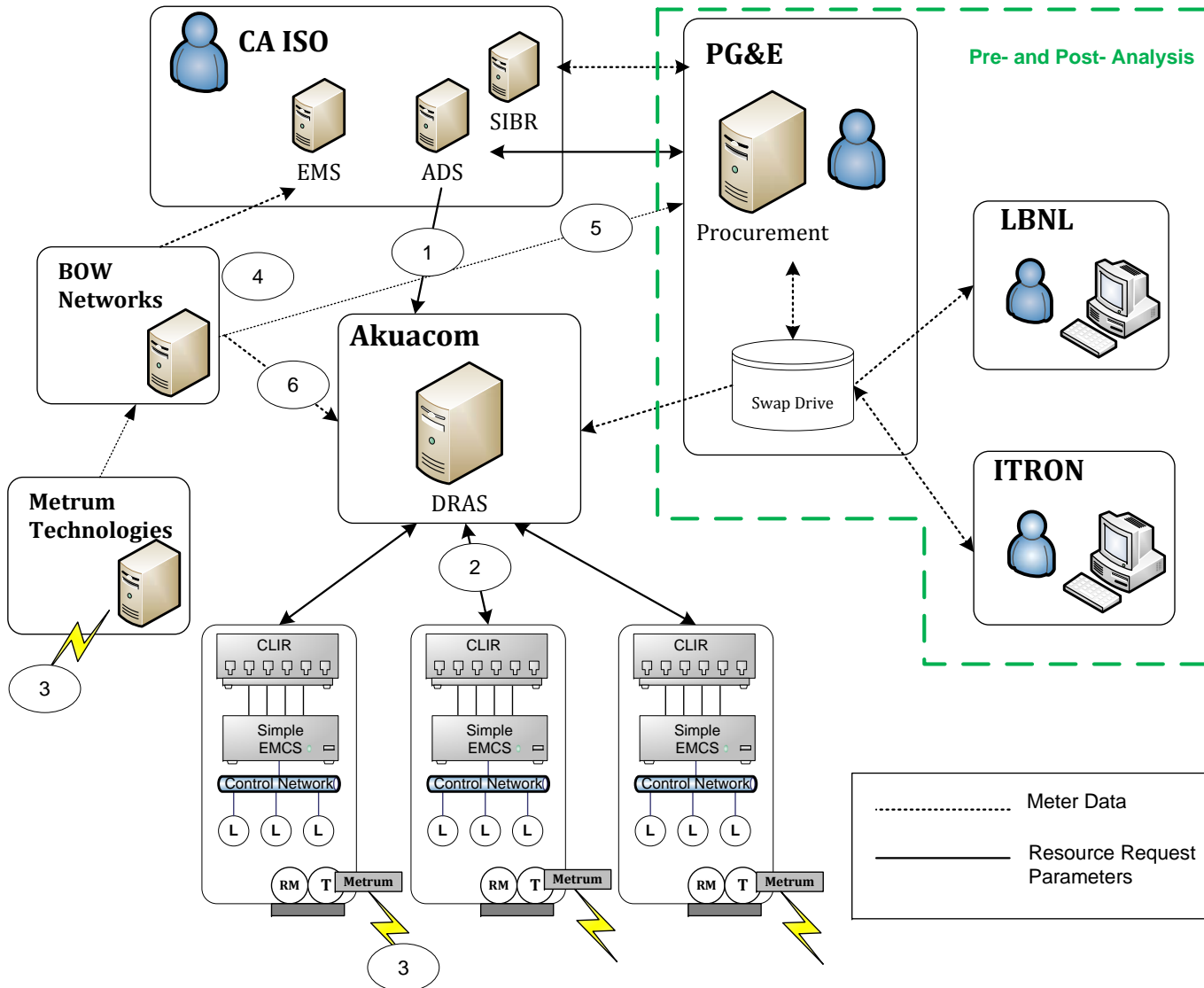


1. Shift load to maximize use of wind

2. Facilitate smoother ramp

3. Provide reserves to manage forecast error and intra-hour variability

Participating Load Pilot Telemetry



Acronyms:

EMS – Energy Management System

ADS – Automatic Dispatch System

SIBR – Scheduling Infrastructure Business Rules

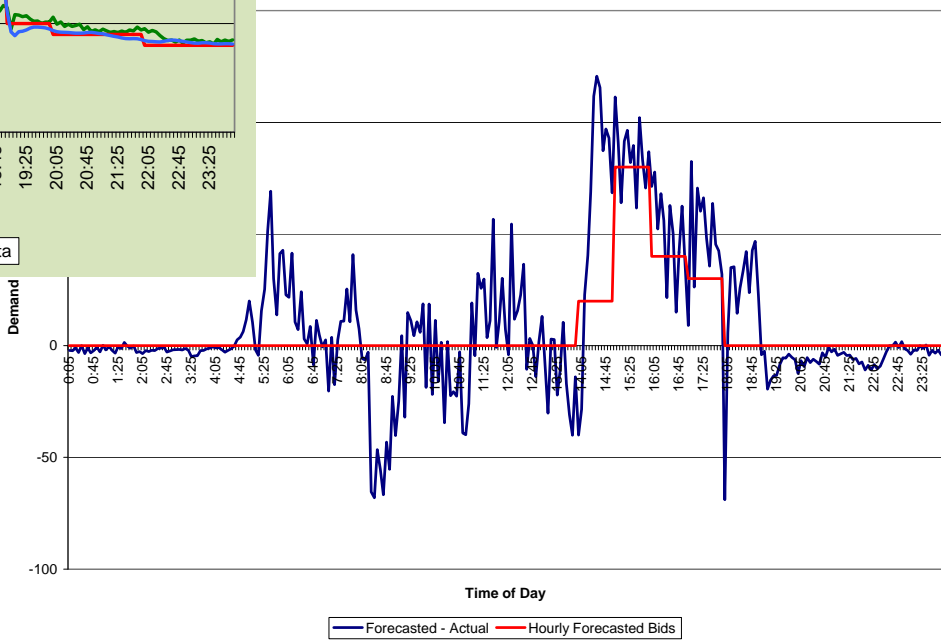
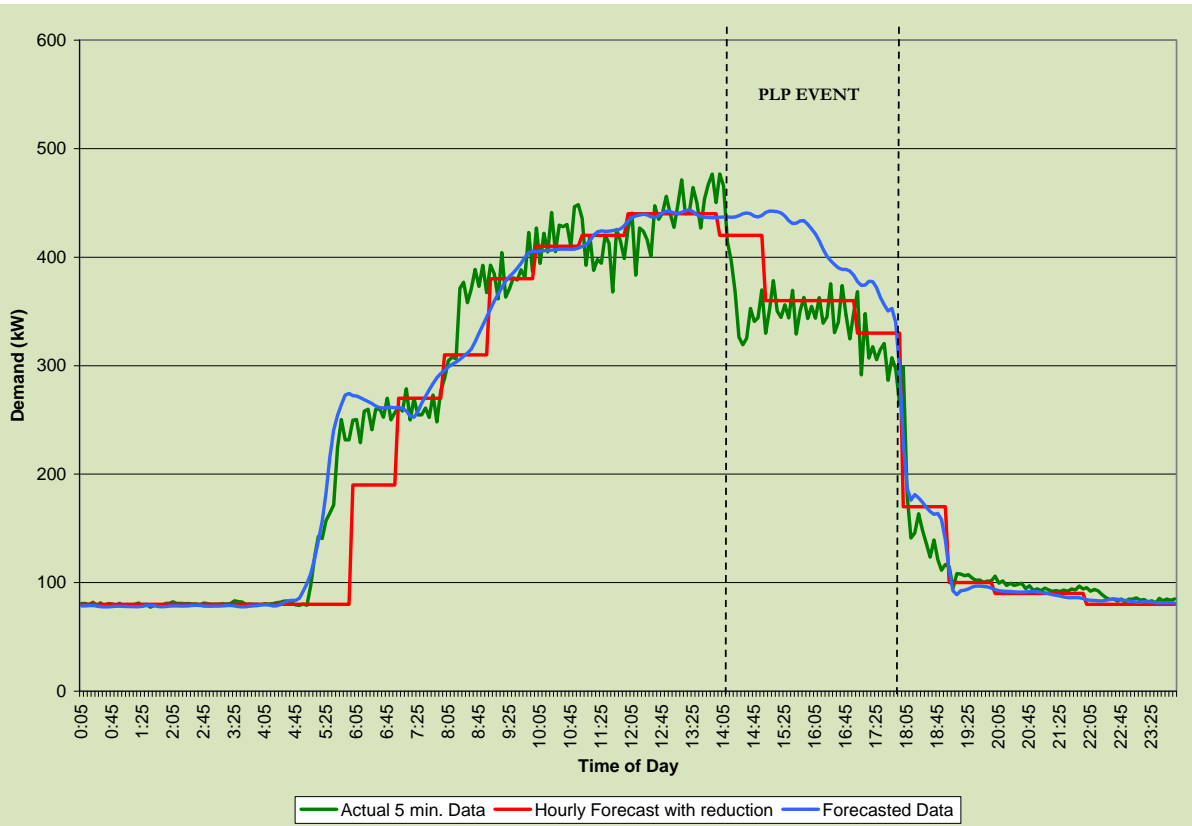
DRAS – DR Automation Server

CLIR – Client Logic with Integrated Relay

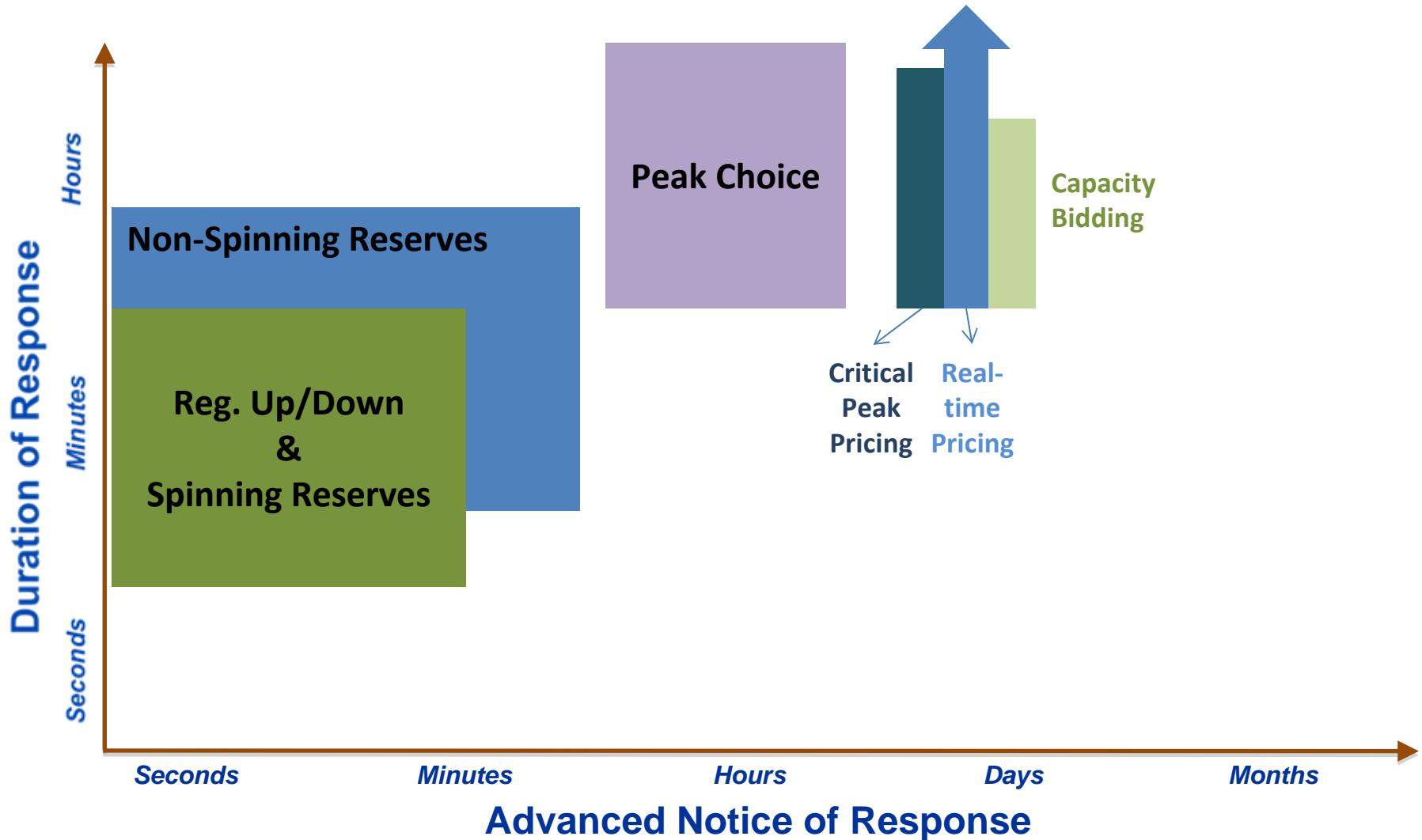
RM – Revenue Meter

T – Telemetry

Contra Costa County Building



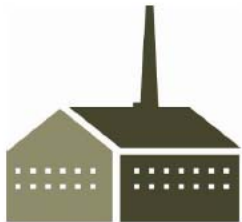
Demand Response Opportunities: Advance Notice and Duration of Response



End Uses and Response



End Use	Type	Modulate	On/Off	Max. Response Time
HVAC	Chiller Systems	Setpoint Adj.		15 min.
	Package Unit	Setpoint Adj.	Disable Compressors	5 min.
Lighting	Dimmable	Reduce Level		5 min.
	On/Off		Bi-Level Off	5 min.
Refrig/Frozen Warehouse		Setpoint Adj.		15 min.
Data Centers		Setpoint Adj., Reduce CPU Processing		15 min.
Ag. Pumping			Turn Off selected pumps	5 min.
Wastewater			Turn Off selected pumps	5 min.



Summary and Future Research



Summary

OpenADR growing in use and scope

Need to link advanced controls for efficiency and DR

Future research

- **Additional end-use load field and stock evaluations**
- **Closer analysis of economics**
- **Continue to explore load and DR predictions**