Buildings and the Smart Electric Grid

Building Product Manufacturers Alliance

Speaker Series
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DRRC Demand Response Research Center

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Presentation Overview

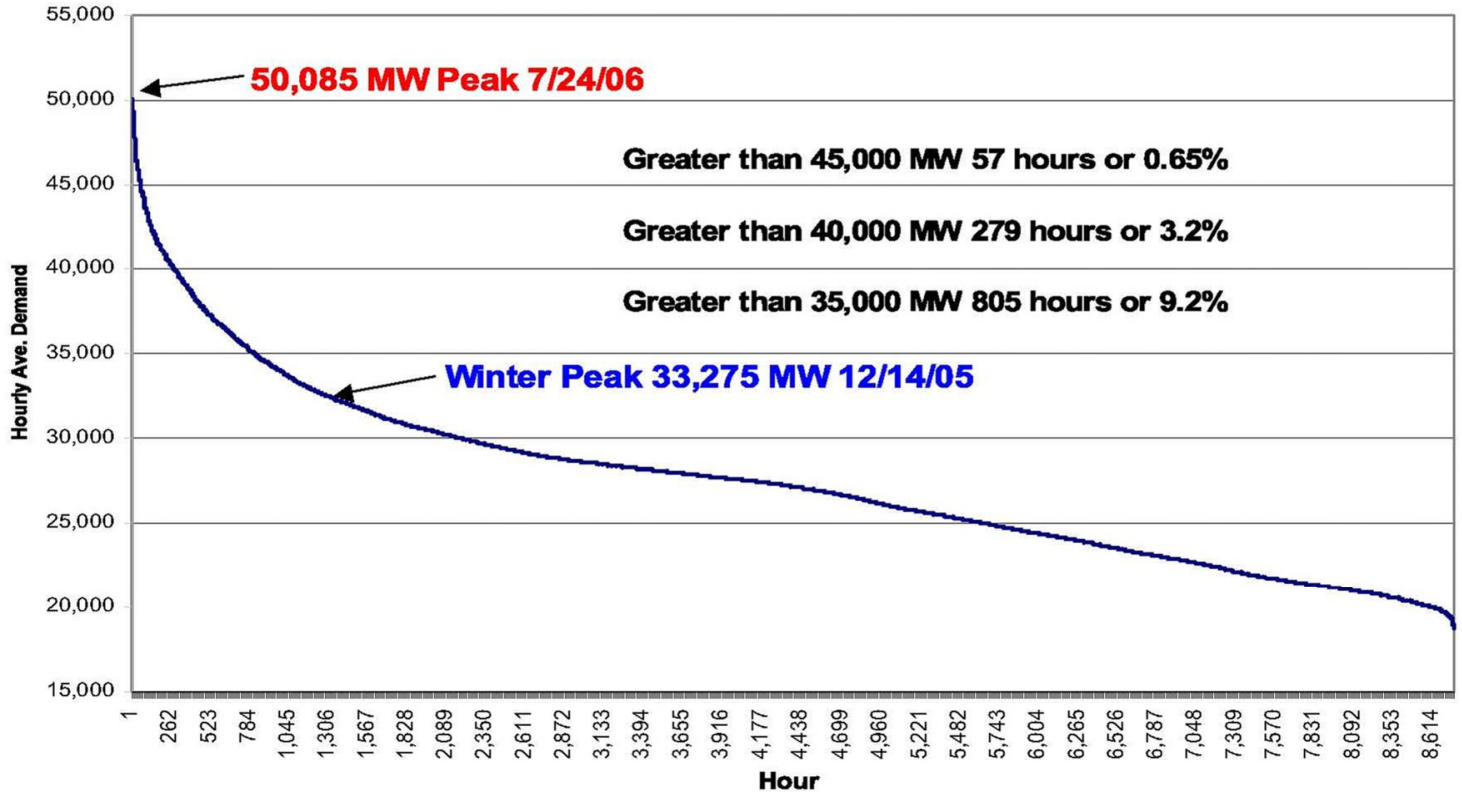
- Introduction to Demand Response in California
- Automating DR
- Linking DR and Energy Efficiency
- Research at LBNL and Future Directions

California ISO
Your Link to Power

California Independent
System Operator Corporation

CAISO Load Duration Curve

Sept '05 to Sept '06



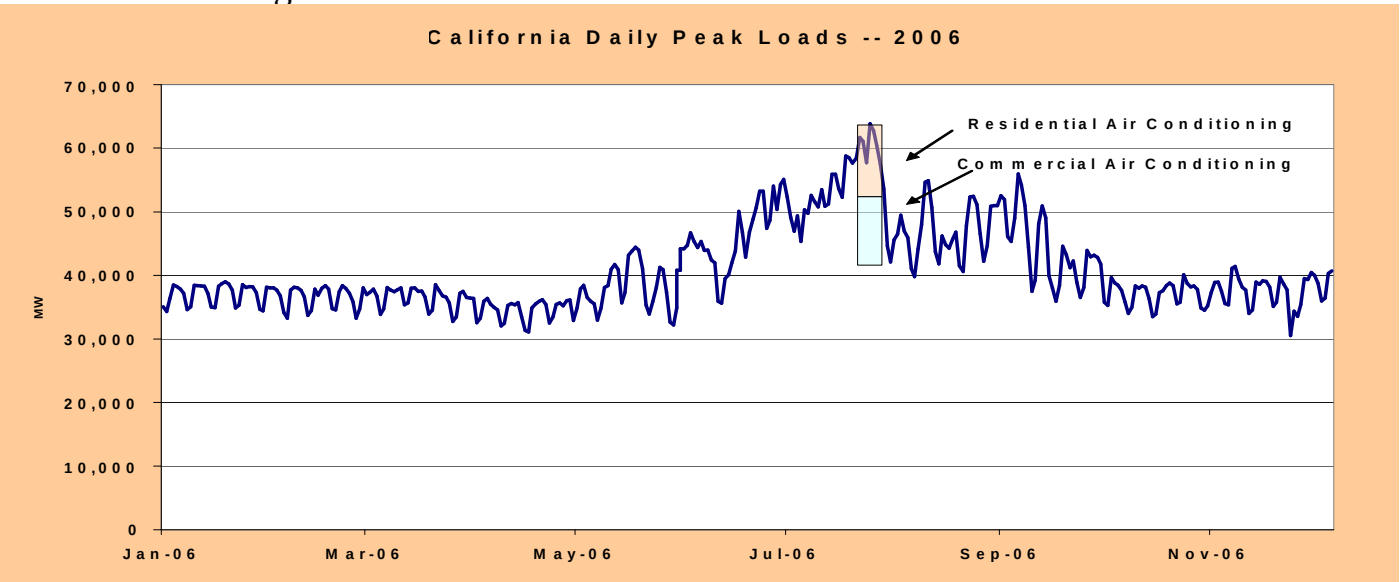
Definition and Technology Needs

DR Definition: Action to reduce load when

- Contingencies occur that threaten supply-demand balance
- Market conditions occur that raise supply costs
  - peak-load reductions different from efficiency, transient vs. permanent

DR Communications Infrastructure Needs

- Create real-time, automated DR infrastructure to respond to changing contingency and market conditions
- DR infrastructure should coexist with legacy systems, technology and tariff improvements, with near- and long-term benefits.



EPACT 2005 – Smart Metering

IN GENERAL.—It is the policy of the United States to encourage States to coordinate, on a regional basis, State energy policies to provide reliable and affordable demand response services to the public.

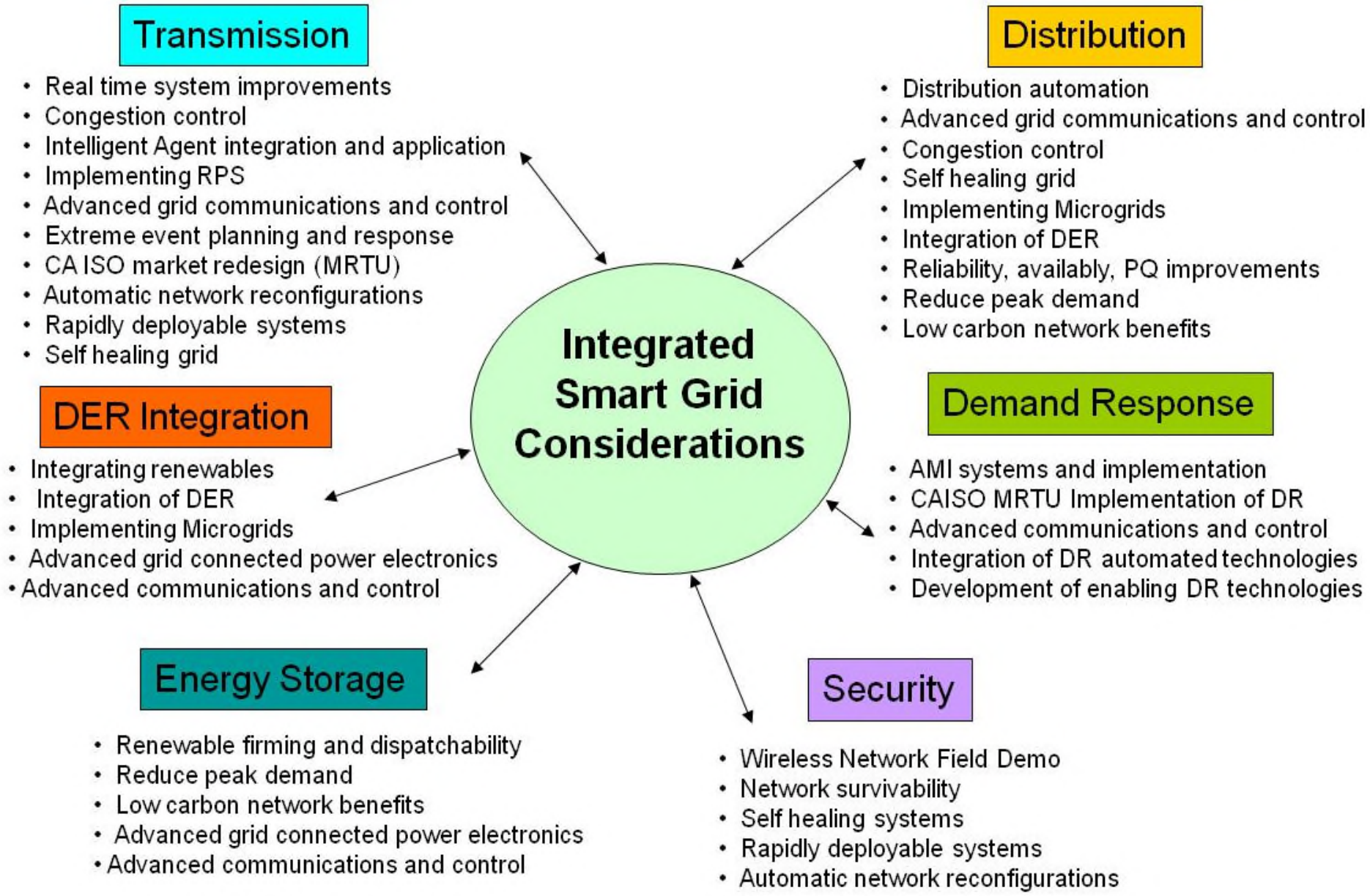
Section 1252(f):

FEDERAL ENCOURAGEMENT OF DEMAND RESPONSE DEVICES.

It is the policy of the US that time-based pricing and other forms of DR, whereby electricity customers are provided with electricity price signals and the ability to benefit by responding to them, shall be encouraged,

The deployment of such technology and devices that enable electricity customers to participate in such pricing and demand response systems shall be facilitated, and unnecessary barriers to demand response participation in energy, capacity and ancillary service markets shall be eliminated.

It is further the policy of the US that the benefits of such demand response that accrue to those not deploying such technology and devices, but who are part of the same regional electricity entity, shall be recognized.

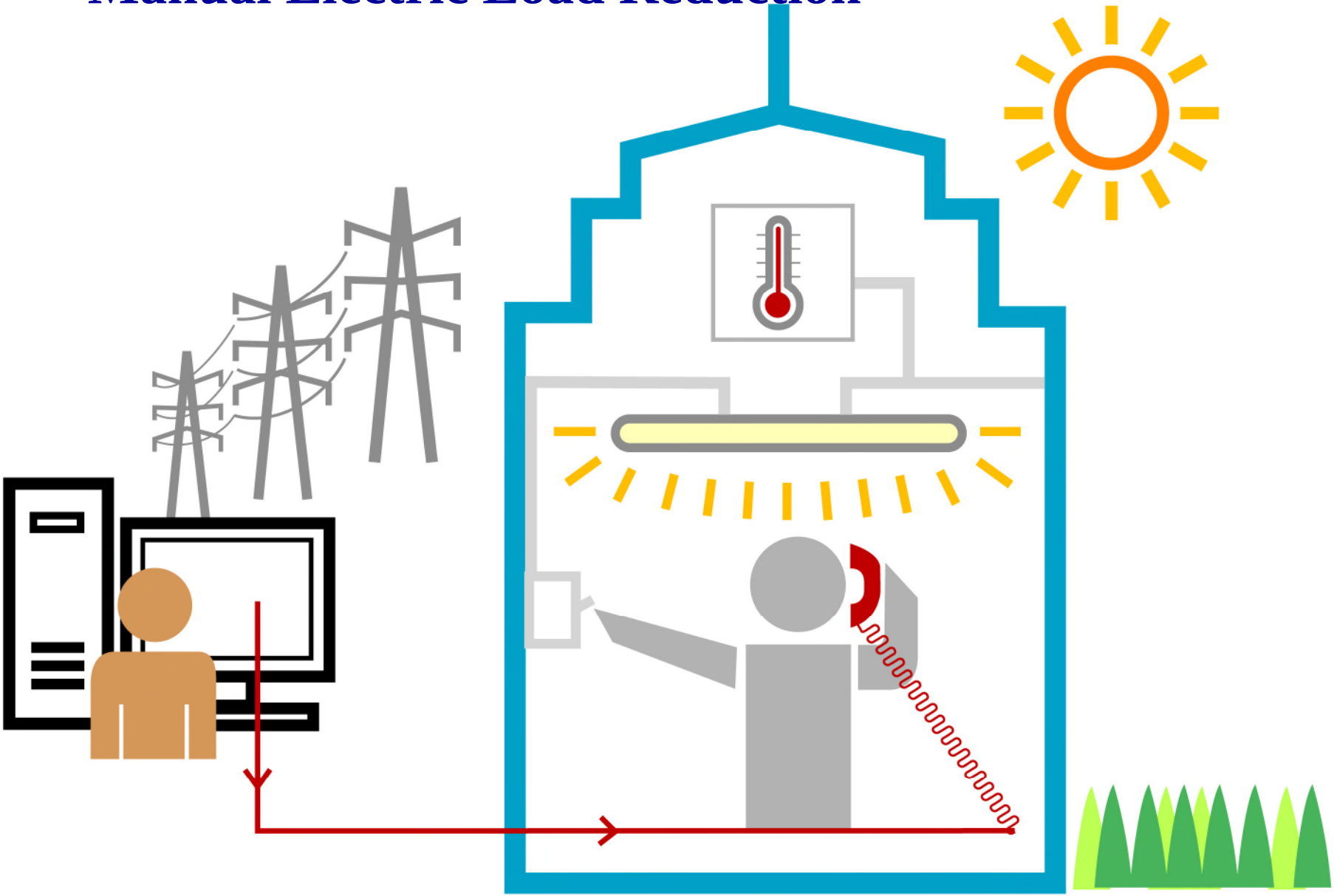

Transmission
• Real time system improvements
• Congestion control
• Intelligent Agent integration and application
• Implementing RPS
• Advanced grid communications and control
• Extreme event planning and response
• CA ISO market redesign (MRTU)
• Automatic network reconfigurations
• Rapidly deployable systems
• Self healing grid
Distribution
• Distribution automation
• Advanced grid communications and control
• Congestion control
• Self healing grid
• Implementing Microgrids
• Integration of DER
• Reliability, availably, PQ improvements
• Reduce peak demand
• Low carbon network benefits
Integrated Smart Grid Considerations
DER Integration
• Integrating renewables
• Integration of DER
• Implementing Microgrids
• Advanced grid connected power electronics
• Advanced communications and control
Demand Response
• AMI systems and implementation
• CAISO MRTU Implementation of DR
• Advanced communications and control
• Integration of DR automated technologies
• Development of enabling DR technologies
Energy Storage
• Renewable firming and dispatchability
• Reduce peak demand
• Low carbon network benefits
• Advanced grid connected power electronics
• Advanced communications and control
Security
• Wireless Network Field Demo
• Network survivability
• Self healing systems
• Rapidly deployable systems
• Automatic network reconfigurations

"Buildings" Side of Demand Side Management

	Efficiency and Conservation (Daily)	*Peak Load Management (Daily)*	*Demand Response (Dynamic Event Driven)*
Motivation	**- Environmental Protection - Utility Bill Savings**	**- TOU Savings - Peak Demand Charge savings - Grid Protection**	- Economic - Reliability - Emergency - Grid Protection
Design	**- Efficient Shell, Equipment & Systems**	**Low Power Design**	Dynamic Control Capability*
Operations	**- Integrated System Operations**	**Demand - Limiting and Shifting**	Demand - Limiting, Shifting, or Shedding
Initiation	**Local**	**Local**	Remote

*Prefer closed loop strategies, granular control

Manual Electric Load Reduction



Automation Goals and Definition

Recent Research Goals

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

Auto-DR Definition - **Fully automated signal for end-use control**

- **Signaling –** Continuous, secure, reliable, 2-way communication with listen and acknowledge signals
- **Industry Standards -** Open, interoperable standard control and 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 are provided to facilitate a diverse set of end-use strategies

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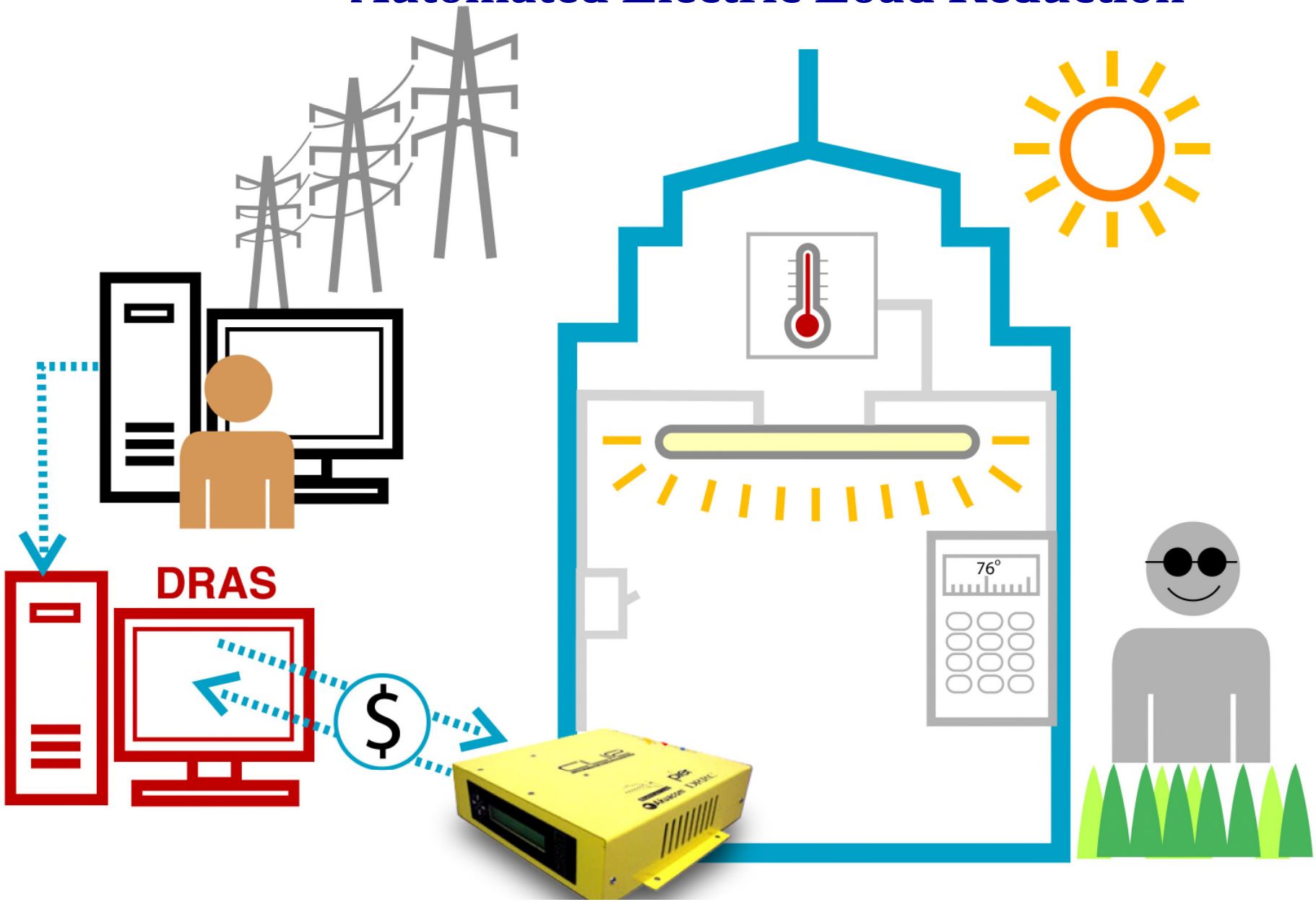
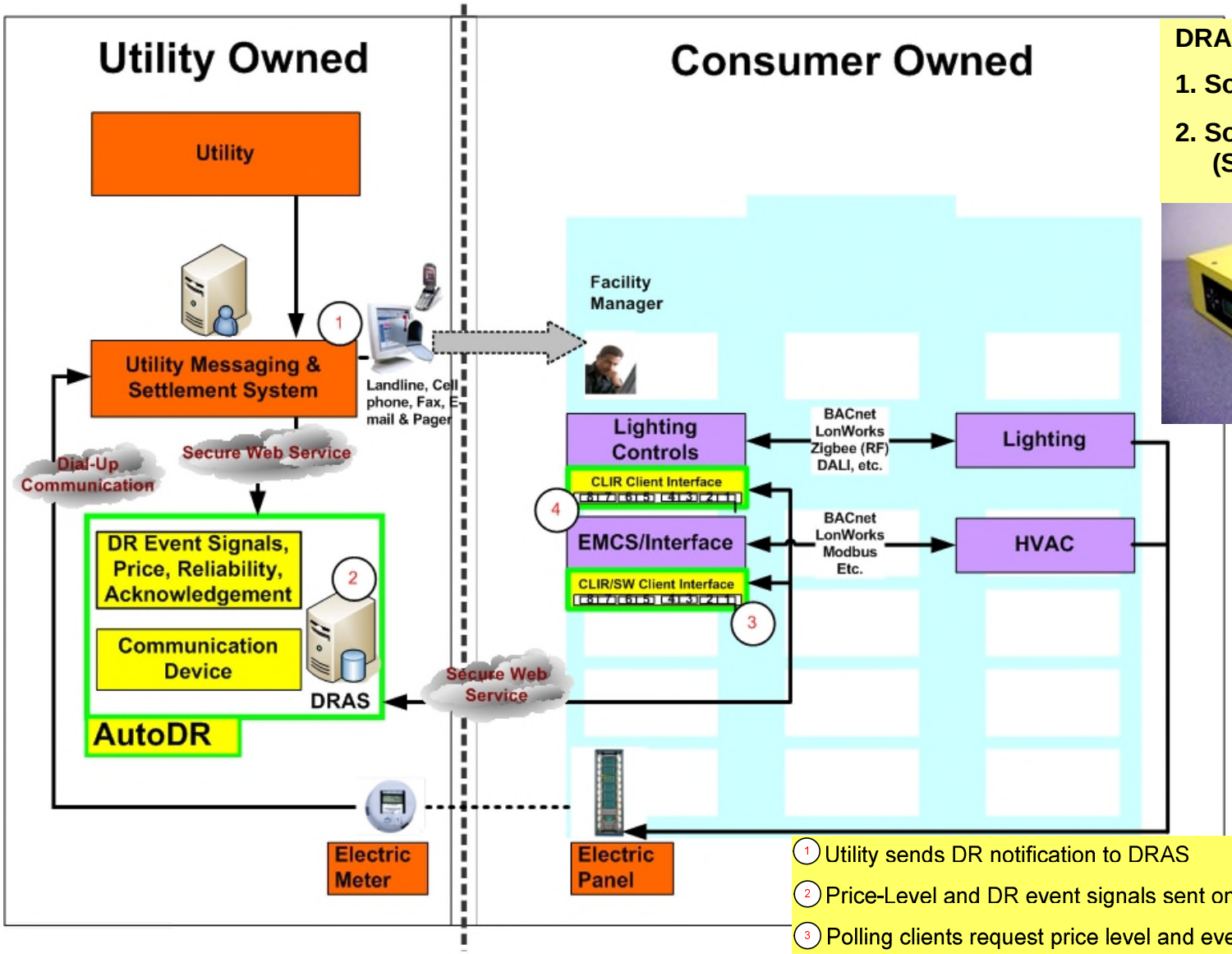
Automated Electric Load Reduction



DR Automation Server and Client

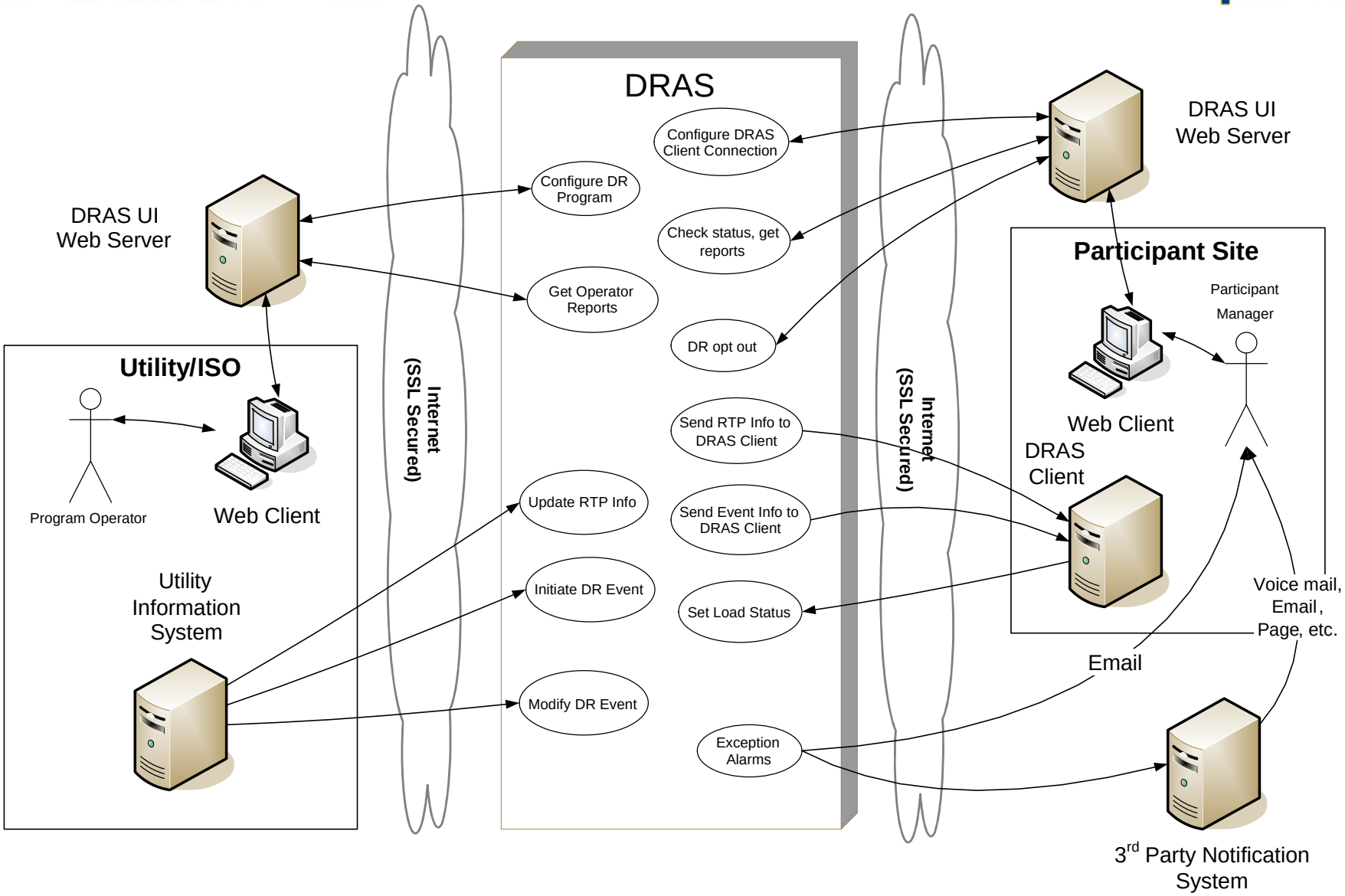


DRAS Clients –

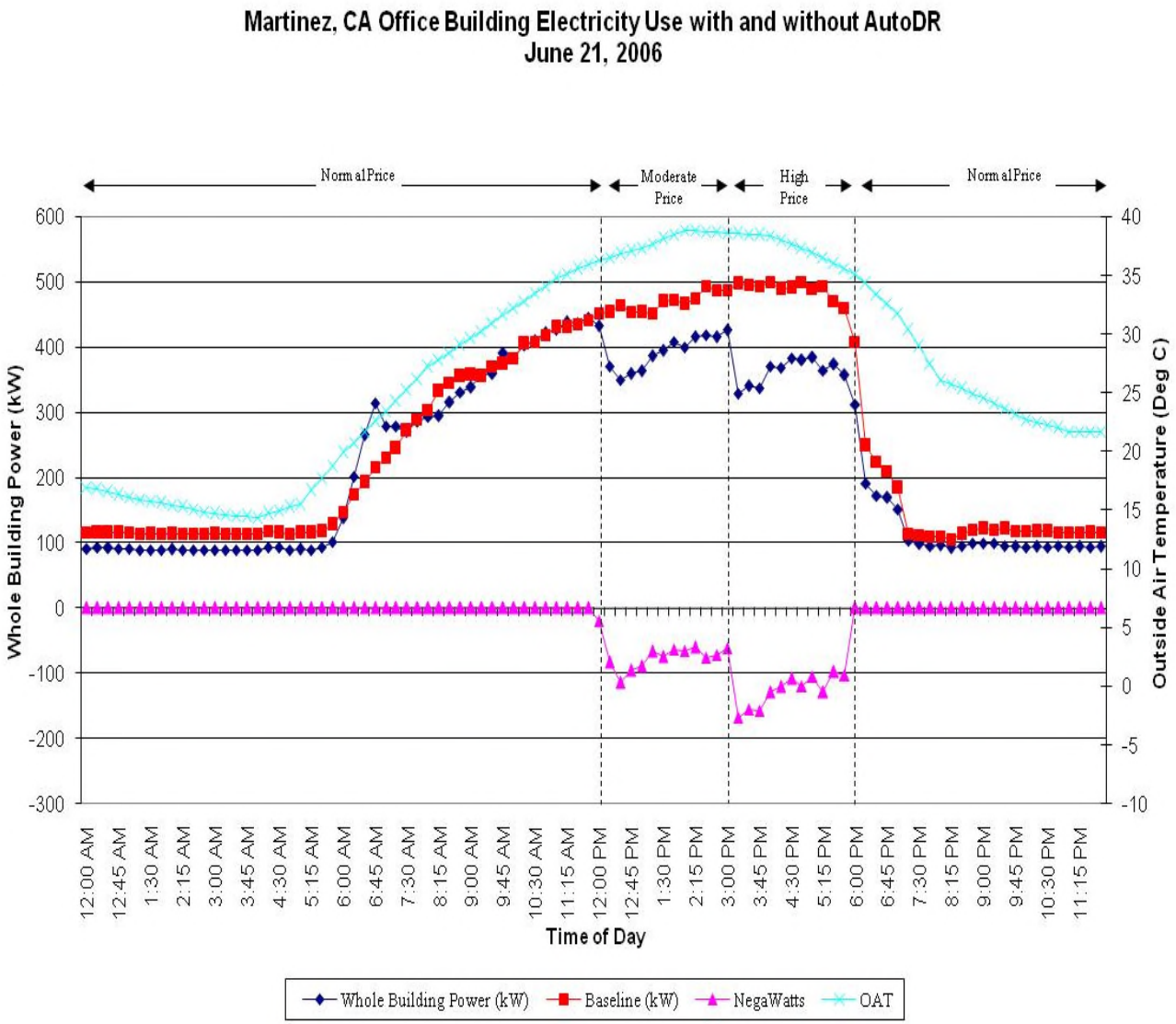
1. **Software only (Smart)**
2. **Software & Hardware (Simple)**

1. Utility sends DR notification to DRAS
2. Price-Level and DR event signals sent on DRAS
3. Polling clients request price level and event data every minute
4. Energy Management Control System (EMCS) and other systems carry out shed based on pre-programmed strategies.

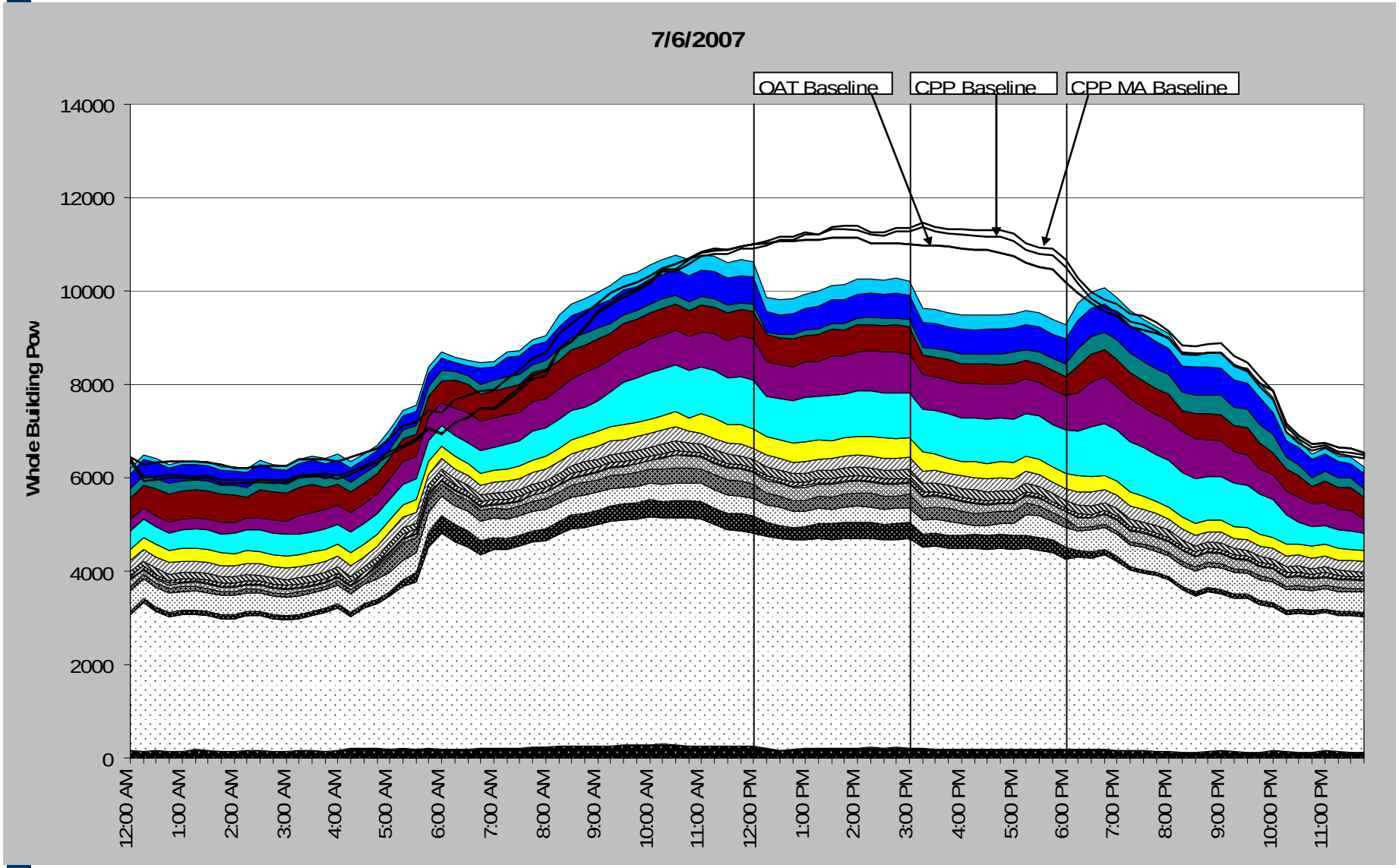
DR Automation Server Event Architecture



Auto-DR in 130,000 ft^2 County Office Current Practice



Results From July 2007



Comparison of End-Use Strategies

Global temperature reset migrating to State Energy Code

		HVAC											Lighting					Other
	Building use	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	Dimmable ballast	Bi-level swtching	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	

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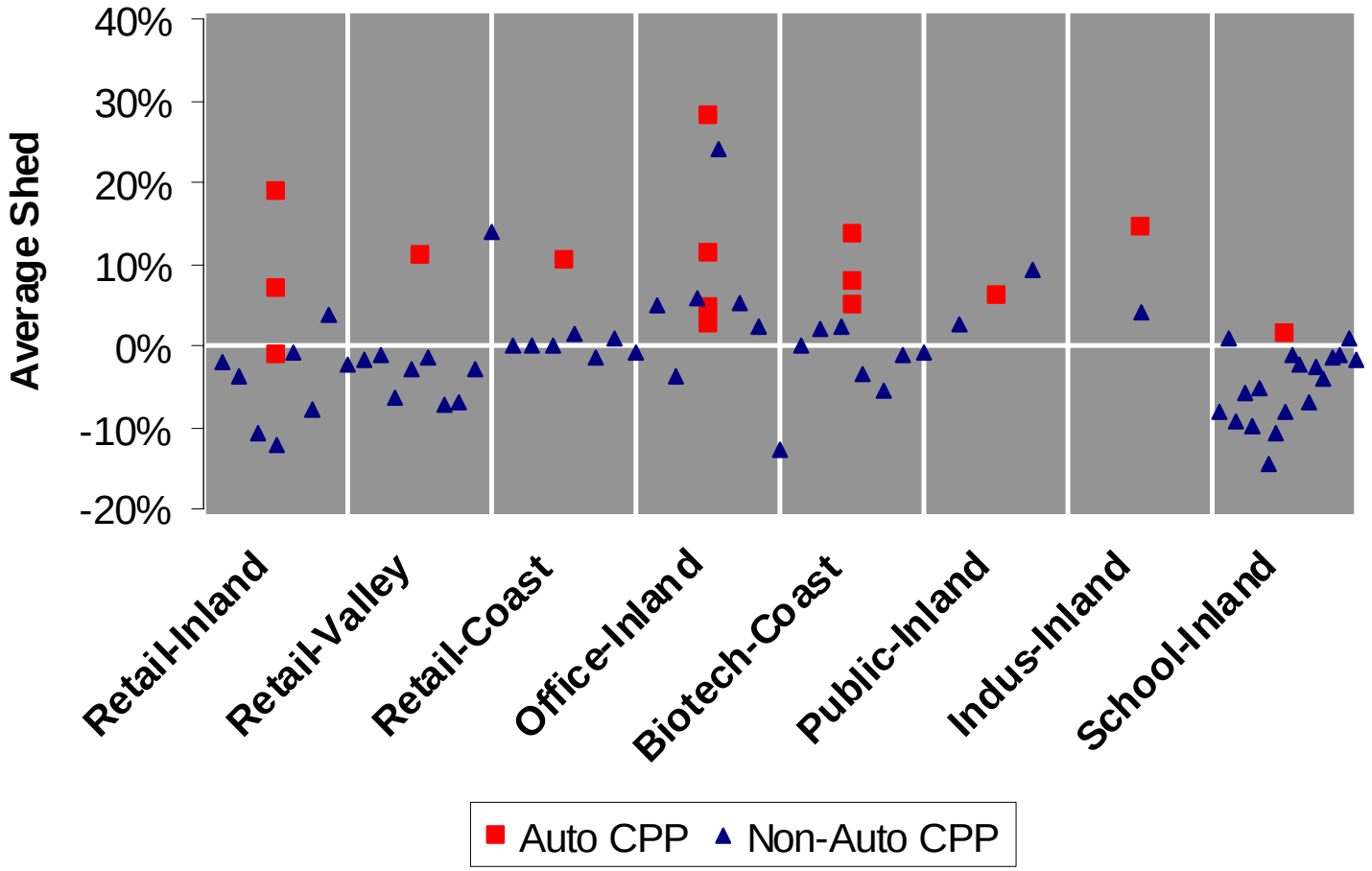
Building Components

- **Majority of DR in HVAC And Lighting**
- **Future Applications**
  - Windows
    - Electrochromic
    - Shades
  - Dynamic Structural Mass
    - Phase Change Materials

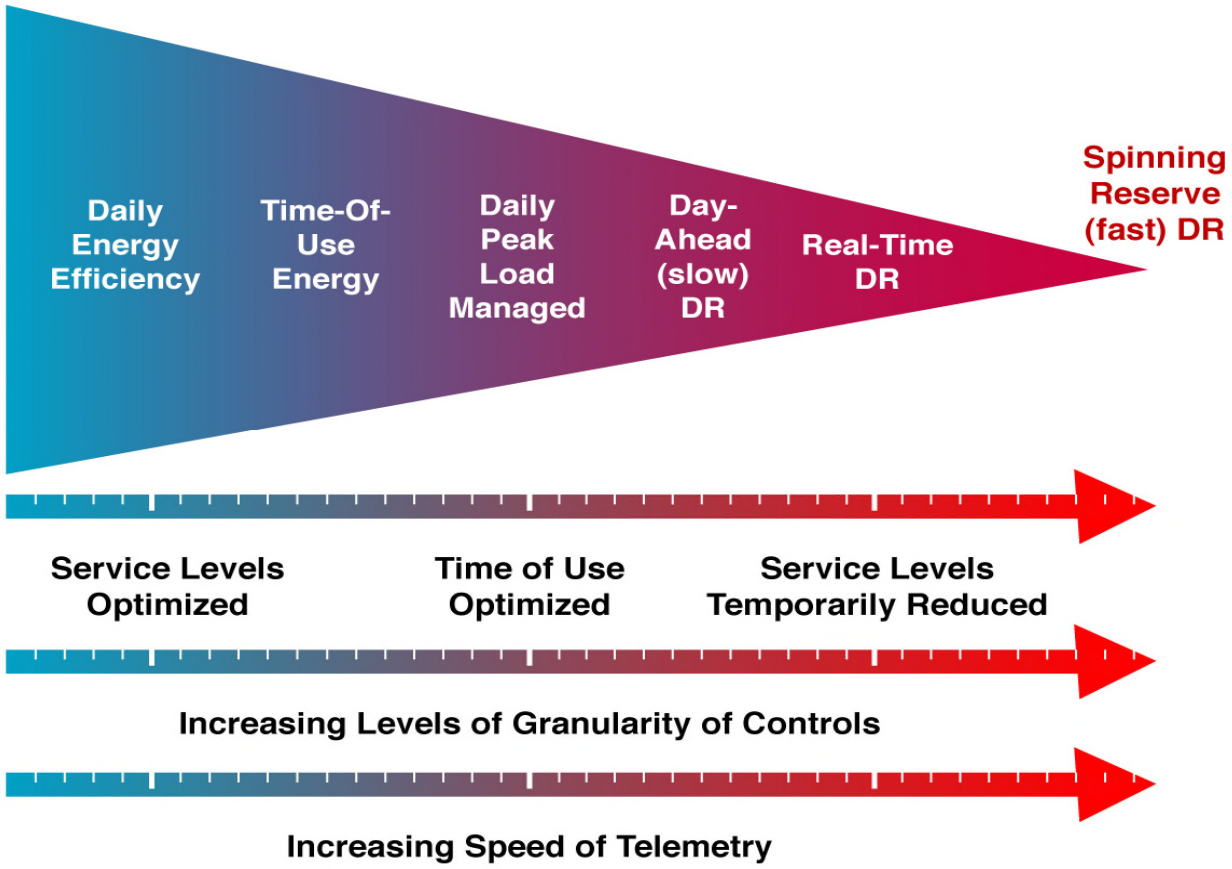
Technical Success
Automated DR saves more than Manual



Automation of DR by Sector

Programmable Communicating Thermostat	Demand Response Automation Client	Demand Response Automation Client
		

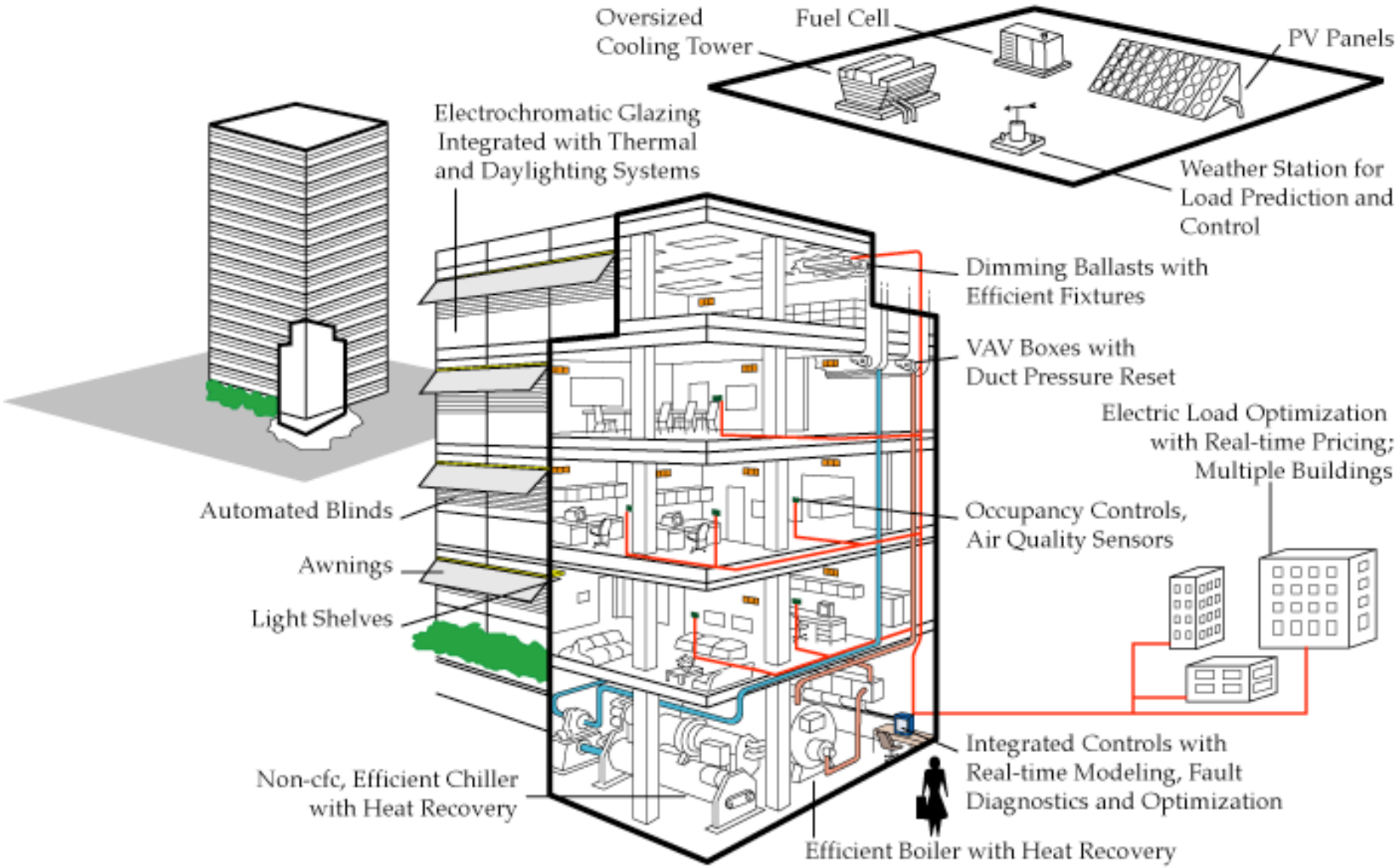
Linking Efficiency* and DR
Technical, Commercial and Policy Impact



Do you know what your building is doing?

Need to make performance **visible**!

Commercial Building with Integrated System Design and Operations



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Making Performance Visible

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