

Load Participating in Ancillary Services Workshop

Large Customers (DR Sellers)

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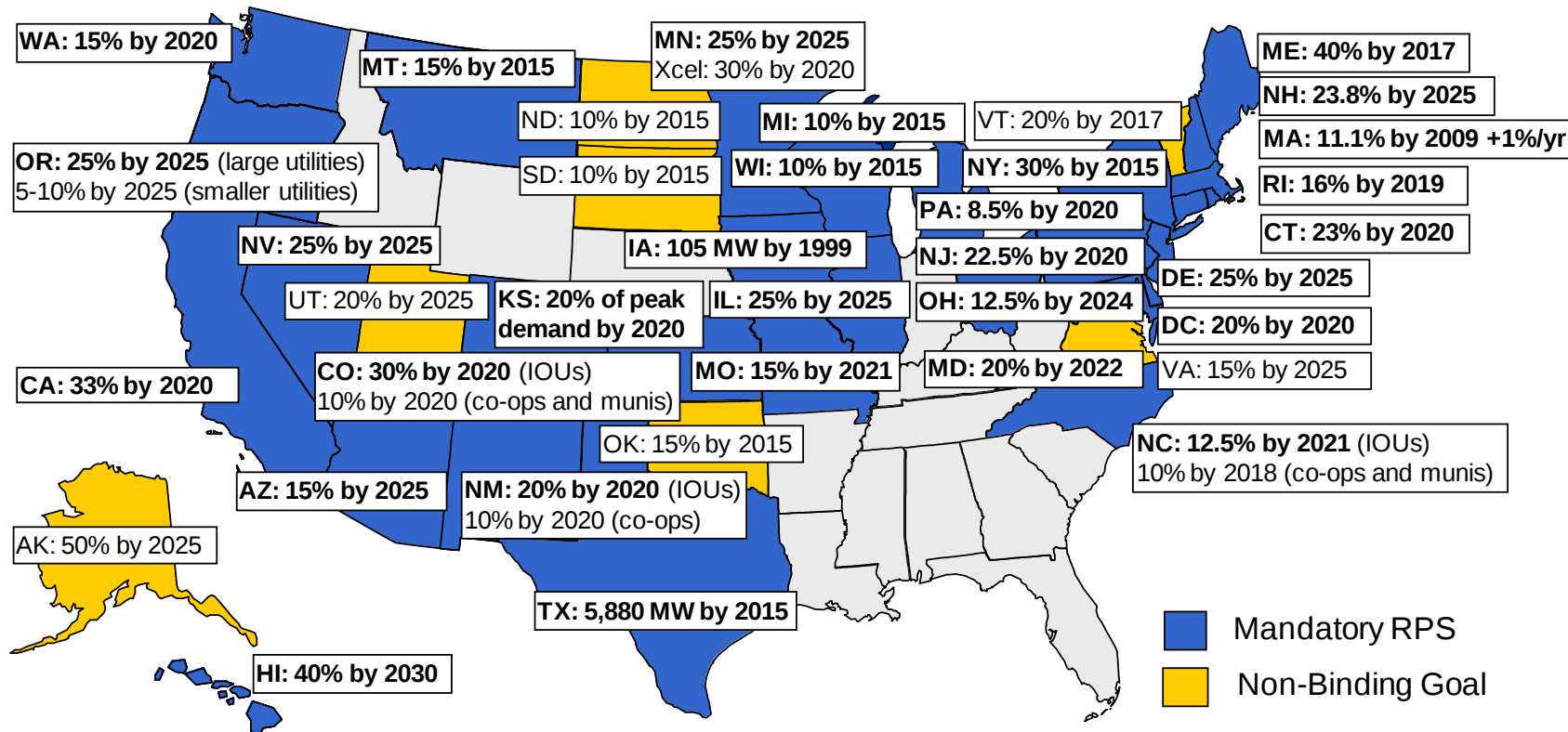
Lawrence Berkeley National Laboratory

Outline



- ❑ Motivation
- ❑ Introduction
 - ❑ DR
 - ❑ Ancillary Services Markets
- ❑ Commercial and Industrial Loads
- ❑ Challenges and Opportunities

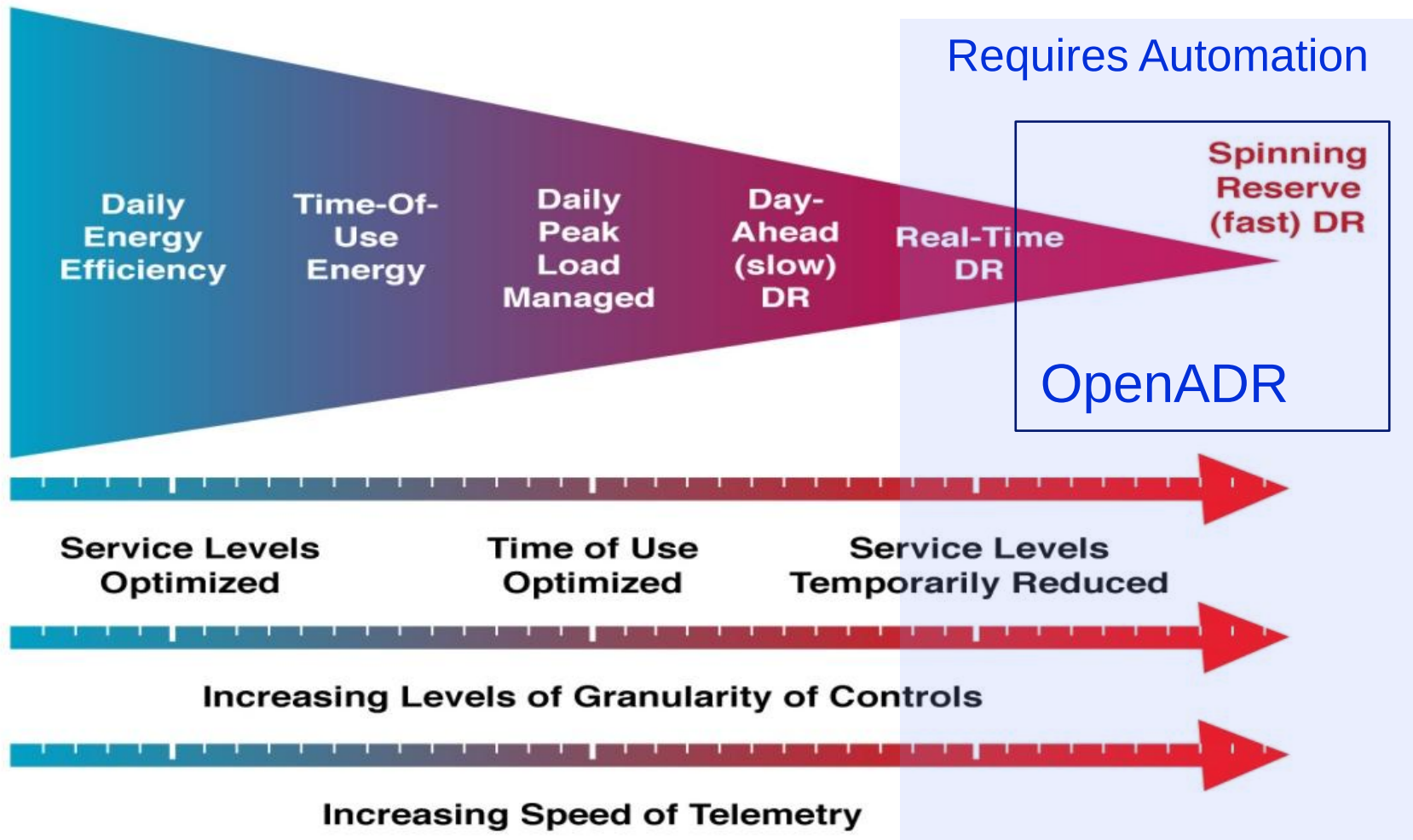
Motivation



Source: Berkeley Lab

- **29 states** and Washington, D.C. have mandatory RPS in place
- Existing RPS policies will apply to 56% of U.S. electricity demand once fully implemented; require 73 GW of new RE capacity by 2025
- Challenges with integration of wind and solar, due to variability and intermittency, include: **intra-hour variability, ramping, forecast error and over-generation**

Demand Response



OpenADR - a National Standard



OpenADR v1.0

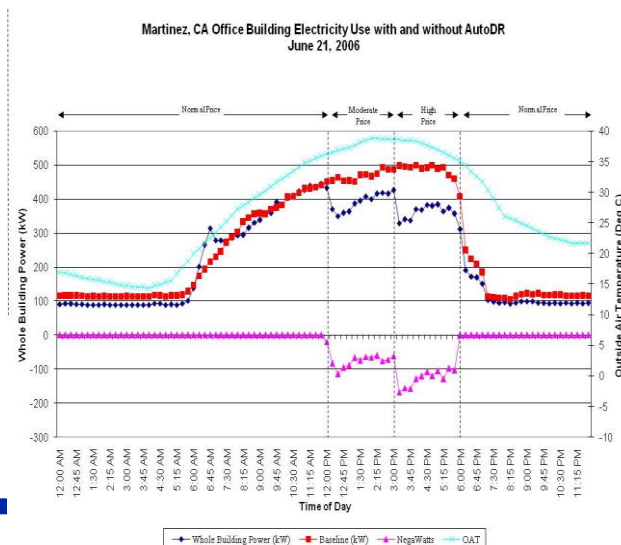
OpenADR 2.0

OpenADR
Commercialization

LBNL/ DRRC Research
(CEC PIER) funded

2002 2003 2004 2005 2006 2007 2008 2009 2010 2011

Pilots and field trials



OpenADR donated to
OASIS and UCAIug

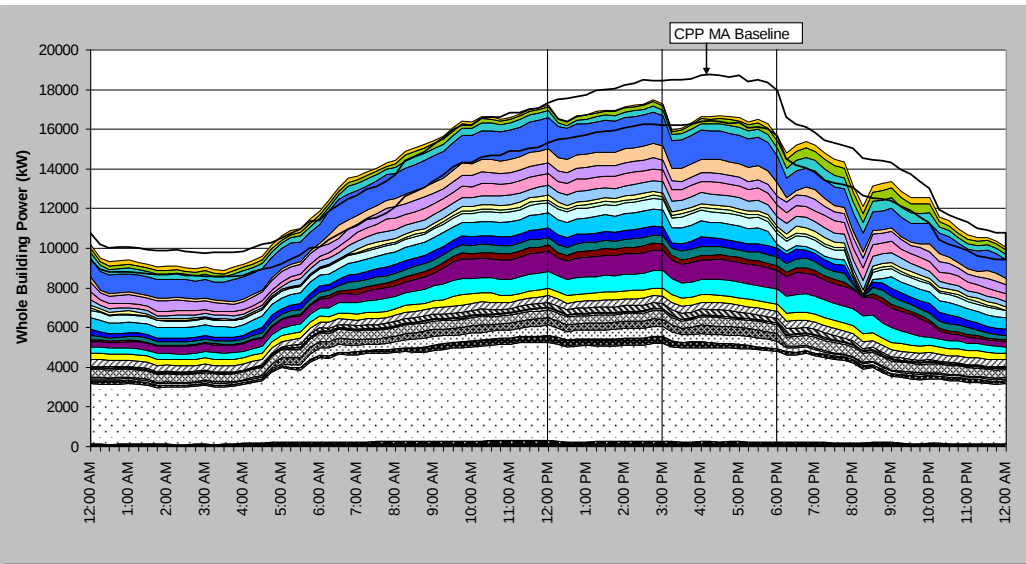
> 70
Companies
with products



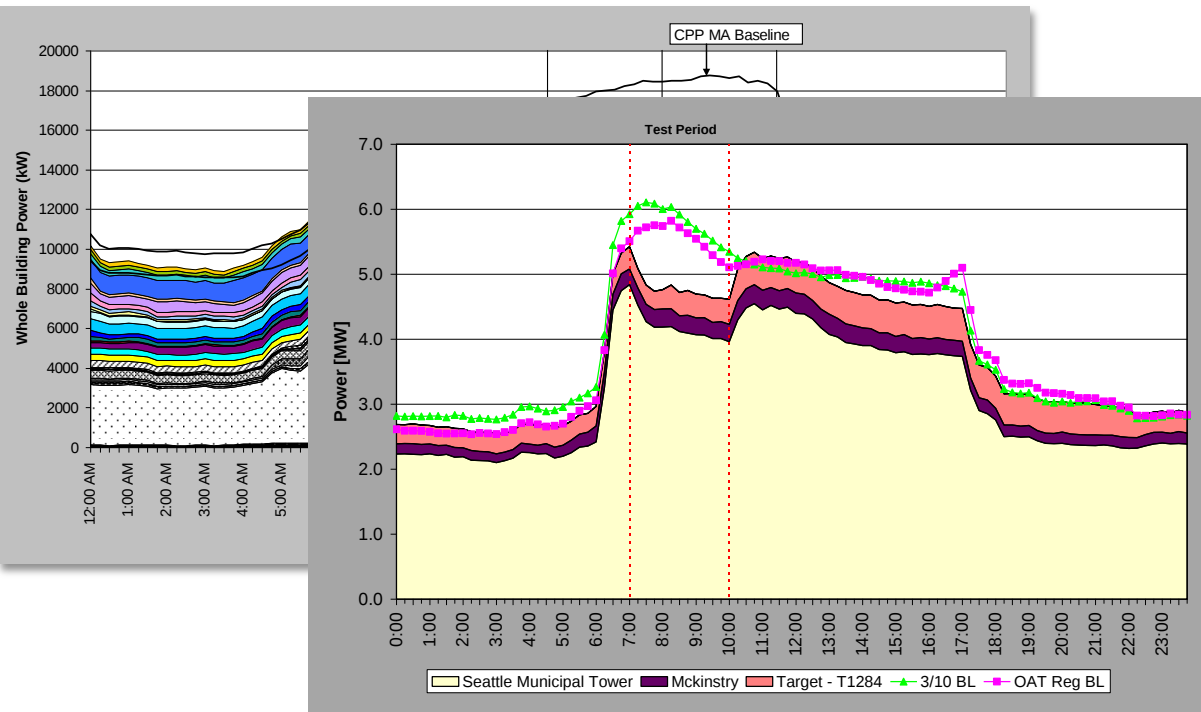
> 200 MW of DR in
California

NATIONAL LABORATORY

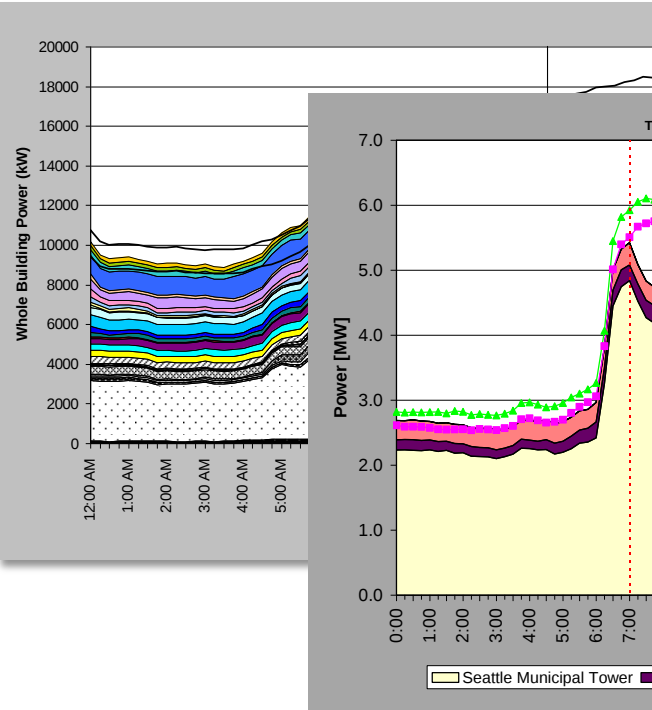
Evolution of OpenADR Applications



Evolution of OpenADR Applications

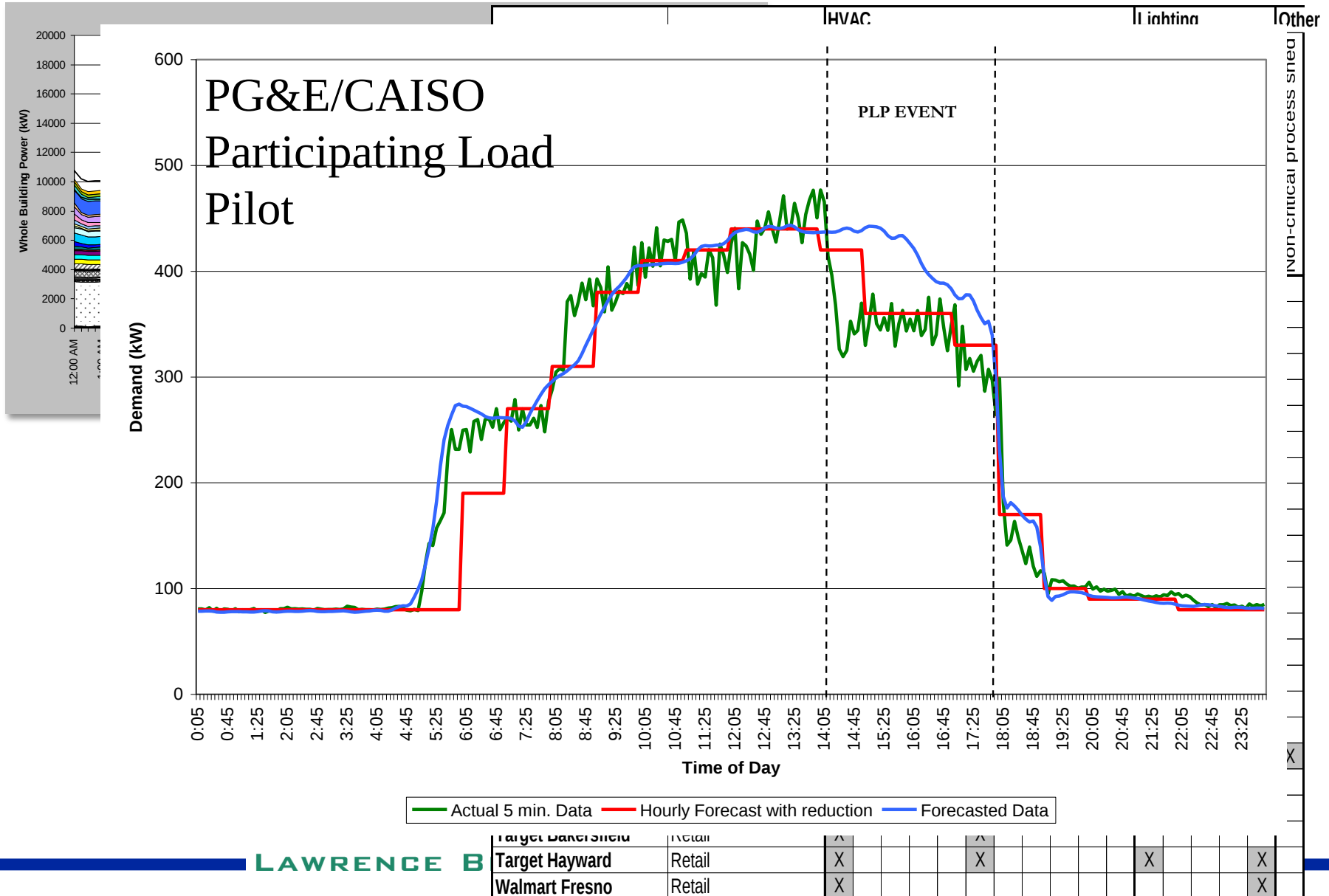


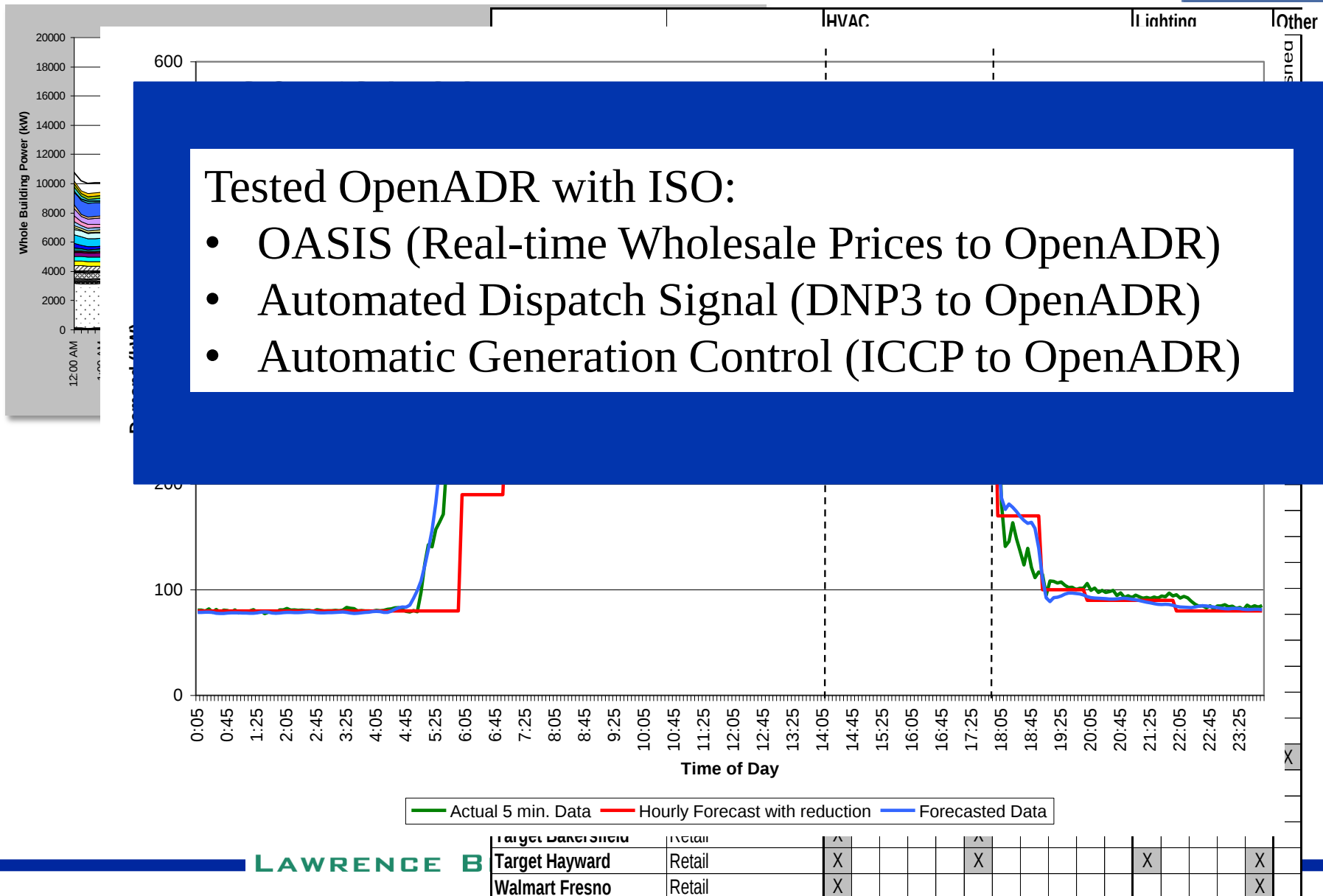
Evolution of OpenADR Applications



		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 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	

Evolution of OpenADR Applications



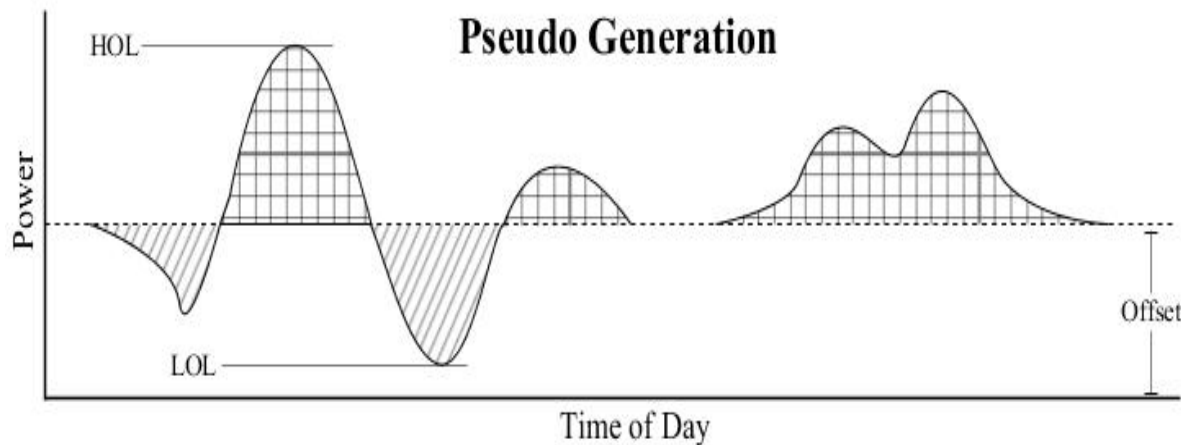
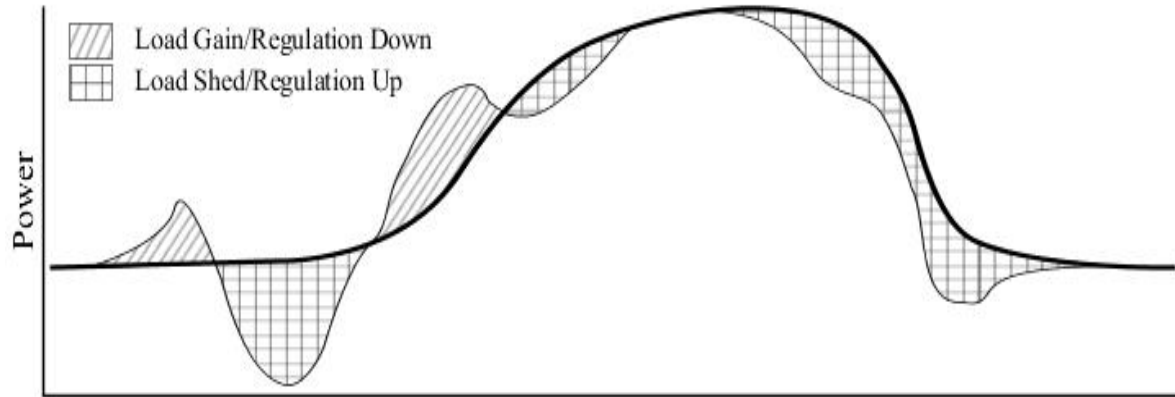


Ancillary Services (CAISO)



Operating Reserves /Ancillary Services Products	Response Time	Duration	Telemetry Requirement
Regulation Up	Start <1 min Reach limit <10 min	15 - 60 min.	4 sec.
Regulation Down	Start <1 min Reach limit <10 min	15 - 60 min.	4 sec.
Non-Spinning Reserves	< 10 min.	30 min.	4 sec. every minute
Spinning Reserves	Instant Start Full output <10 min.	30 min.	4 sec. every minute

DR as a Pseudo Generation



Parameters

- Capacity Available (MW)

HOL - LOL

- Min. Operating Level

LOL

- Max. Operating Level

HOL

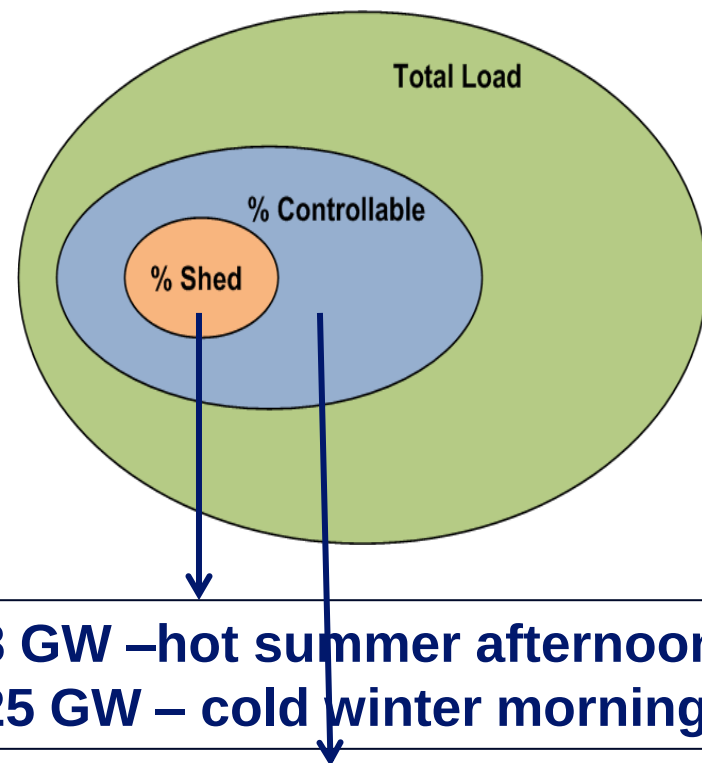
- Ramp Rate (MW/min)

Varies by end use

e.g. HVAC – variable by season, day of week, time of day

Commercial and Industrial Facilities – DR Strategies

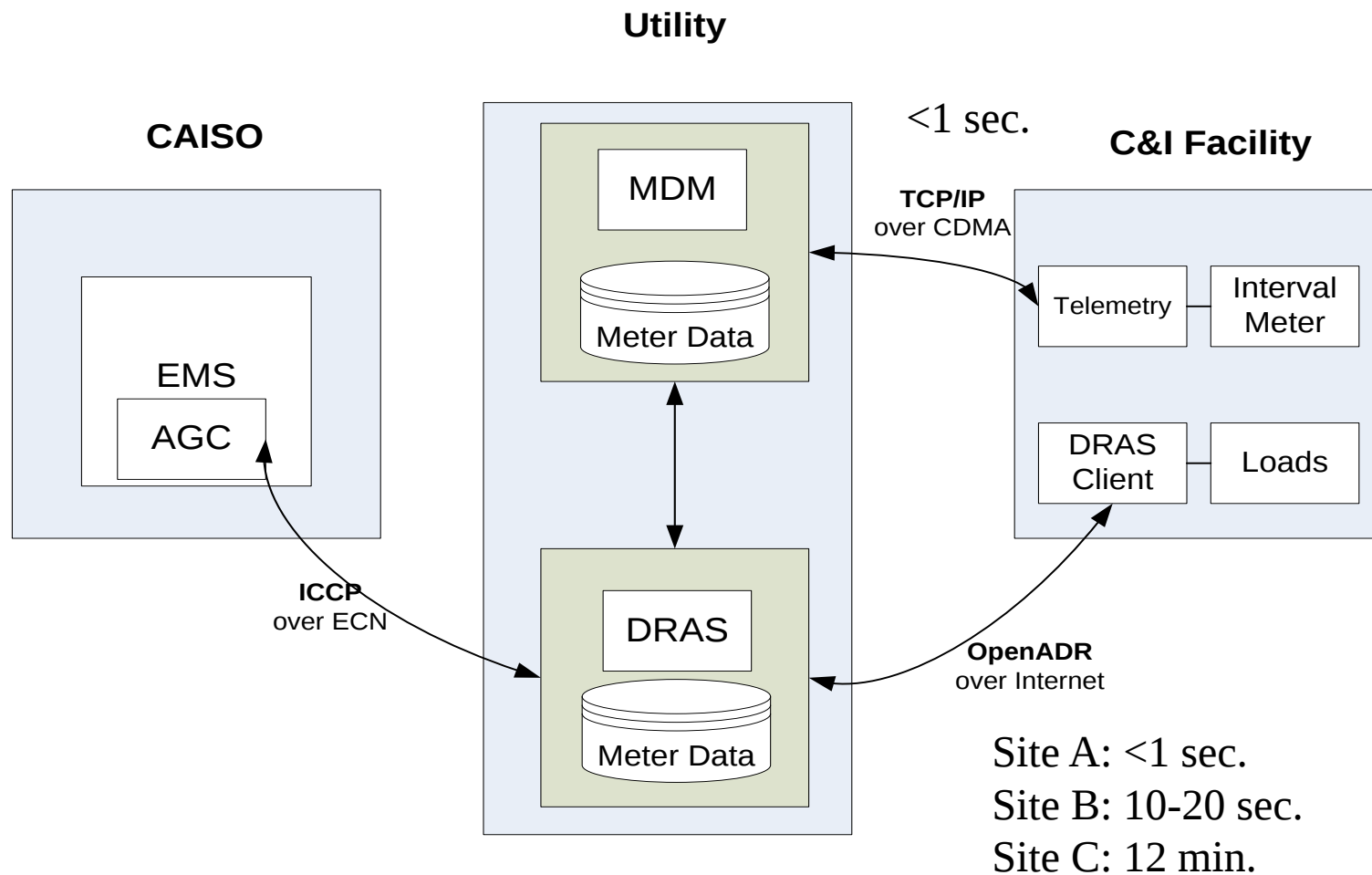
End Use	Type	Ramp Down	Switching Off
HVAC	Chiller Systems	Setpoint Adj.	
	Package Unit	Setpoint Adj.	Disable Compressors
Lighting	Dimmable	Reduce Level	
	On/Off		Bi-Level Off
Refrig/Frozen Warehouse		Setpoint Adj.	
Data Centers		Setpoint Adj., Reduce CPU Processing	
Ag. Pumping			Turn Off selected pumps
Wastewater			Turn Off selected pumps



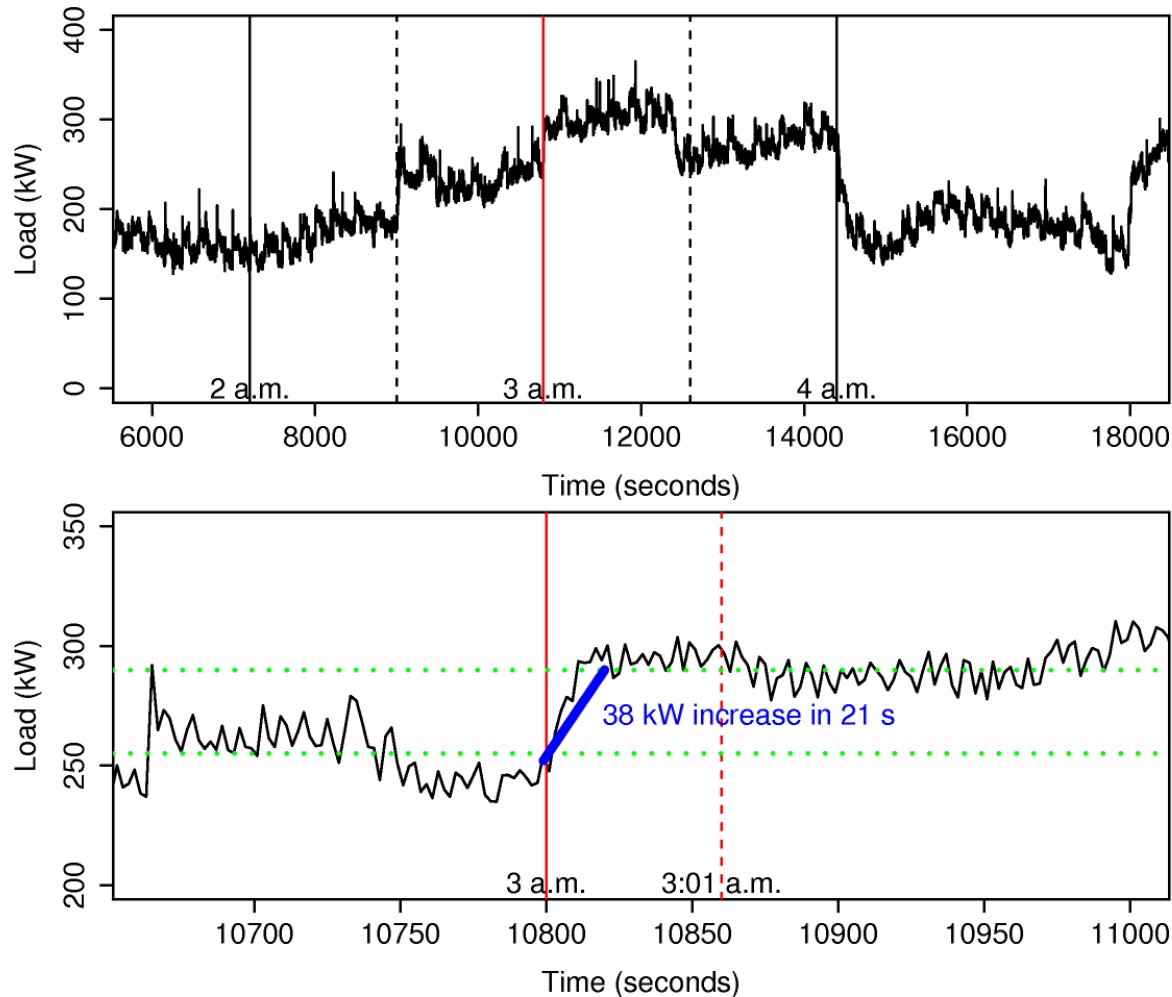
0.8 GW – hot summer afternoon
0.25 GW – cold winter morning

1.8 GW – hot summer afternoon
0.4 GW – cold winter morning

Load as Regulation in California



Load as Regulation in California



ility

terval
meter

oads

ec.

Challenges and Opportunities



- **DR Characterization**
 - Which end-use, how long, how often, how much?
 - Variable ramp rates
 - Individual loads (small vs. large)
 - Aggregation
- **Communication**
 - Security
 - Poll vs. Push
 - Telemetry – technology and cost
- **Controls**
 - Closed-Loop vs. Open-Loop
 - Automation
- **Measurement, Verification and Settlement**
 - Forecast accuracy
- **Economics**
- **Regulatory and Market Issues**

Thank you!



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Demand Response Research Center
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Resources

DRRC Website: <http://drrc.lbl.gov>

Energy Analysis Department Publications:

<http://eetd.lbl.gov/ea/ems/sg-pubs.html>

DR and Ancillary Services: <http://drrc.lbl.gov/system/files/lbni-4189e.pdf>

<http://drrc.lbl.gov/system/files/lbni-2945e.pdf>

DR Strategies Guide: http://drrc.lbl.gov/system/files/59975_0.pdf

Tools: <http://drrc.lbl.gov/tools>

OpenADR: <http://openadr.lbl.gov>, <http://www.openadr.org>