Demand Response - Innovation for Renewable Support

Transmission Research – Paving the Way for Renewables

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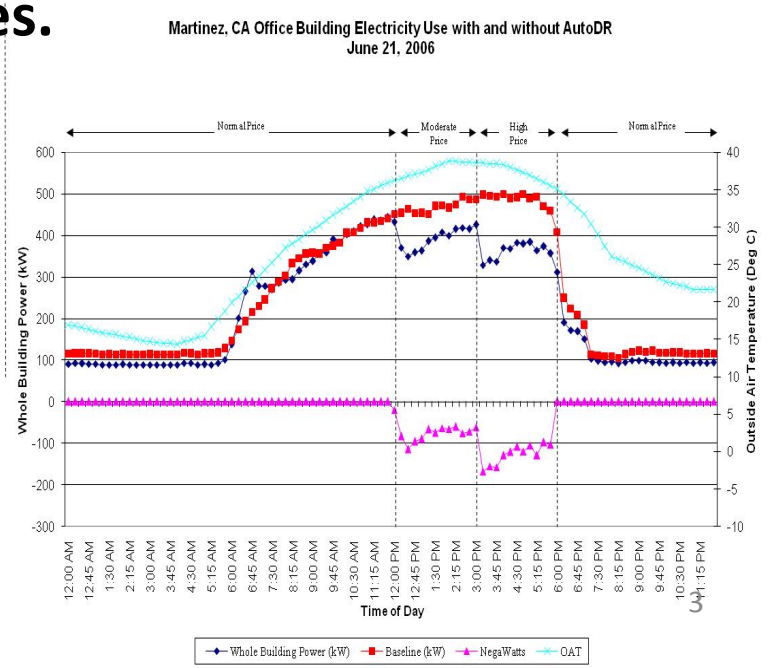
Presentation Outline

- Automation of Demand Response
- Statewide and National Progress
- Linking Demand Response and Renewables
- Future Directions

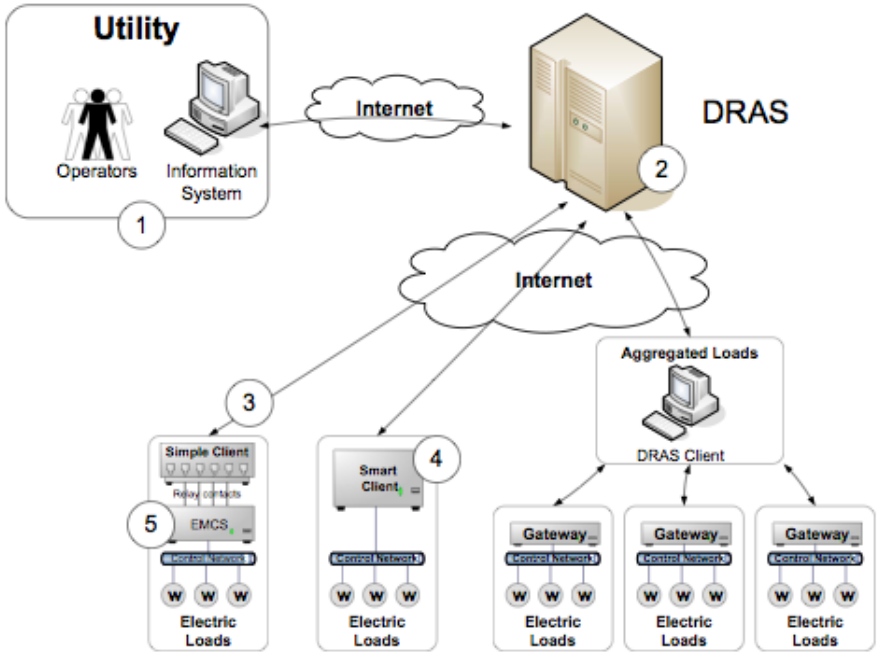
Motivation for Automating Demand Response

- **Automated DR developed to meet goals from 2002**
  - **Cost** - Develop low-cost, automation infrastructure
  - **Technology** - Evaluate "readiness" for common signals
  - **Capability** - Evaluate control strategies to modify electric loads
- **Open Automated Demand Response (OpenADR) is a public domain specification to communicate price and reliability signals**
- **Automated DR programs, offered by utilities or ISOs, automate DR using OpenADR. Programs in 4 states.**



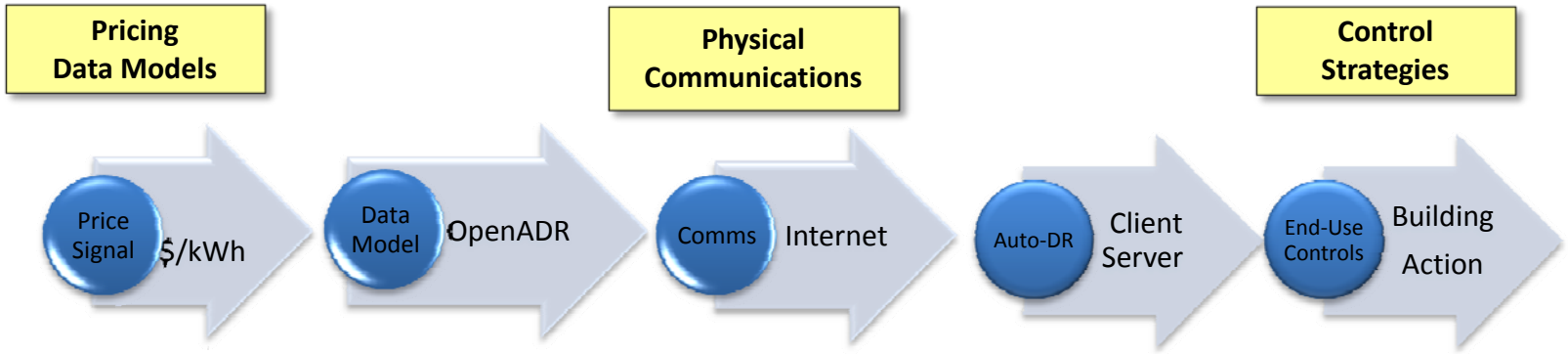
OpenADR Technology Concepts

- **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



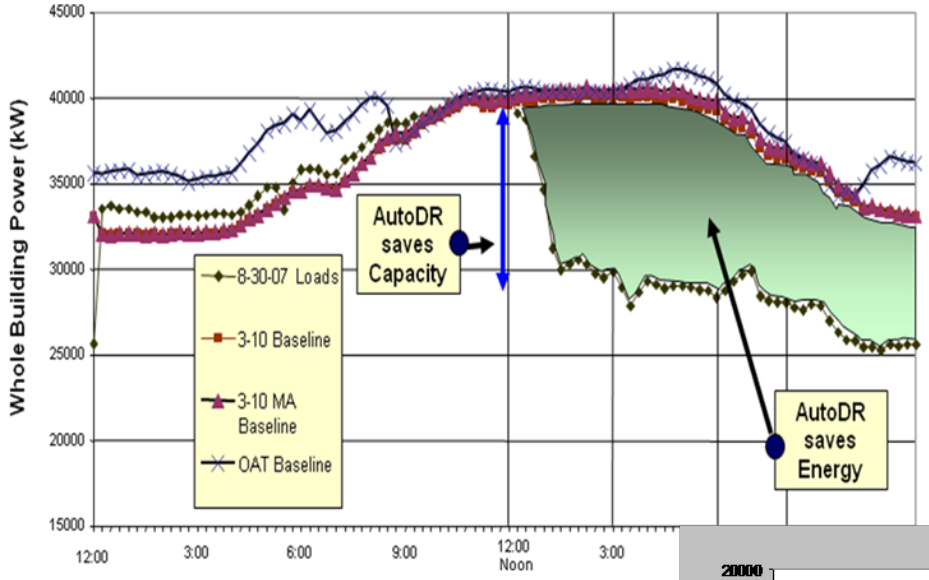
Elements -

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

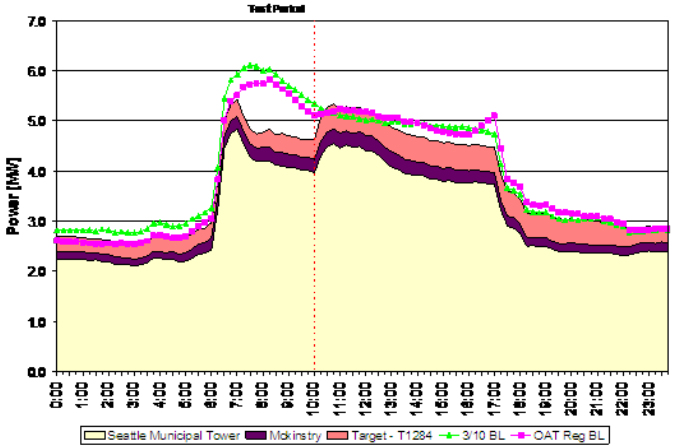


Historic focus on Seasonal Grid Stress

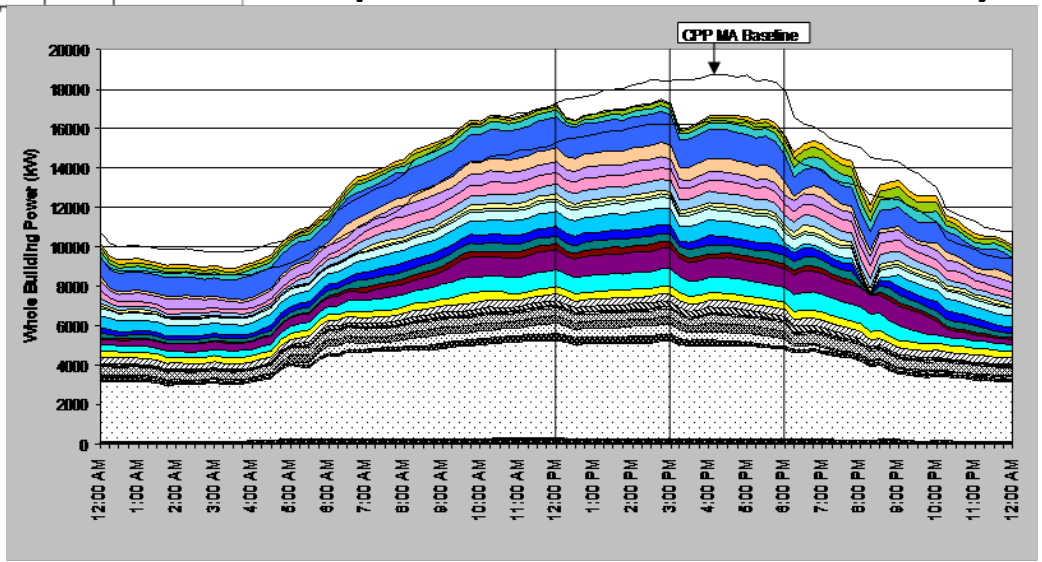
OpenADR PG&E Demand Bid Test Day



OpenADR Northwest Test on Cold Morning



OpenADR Cumulative Shed in July 2008

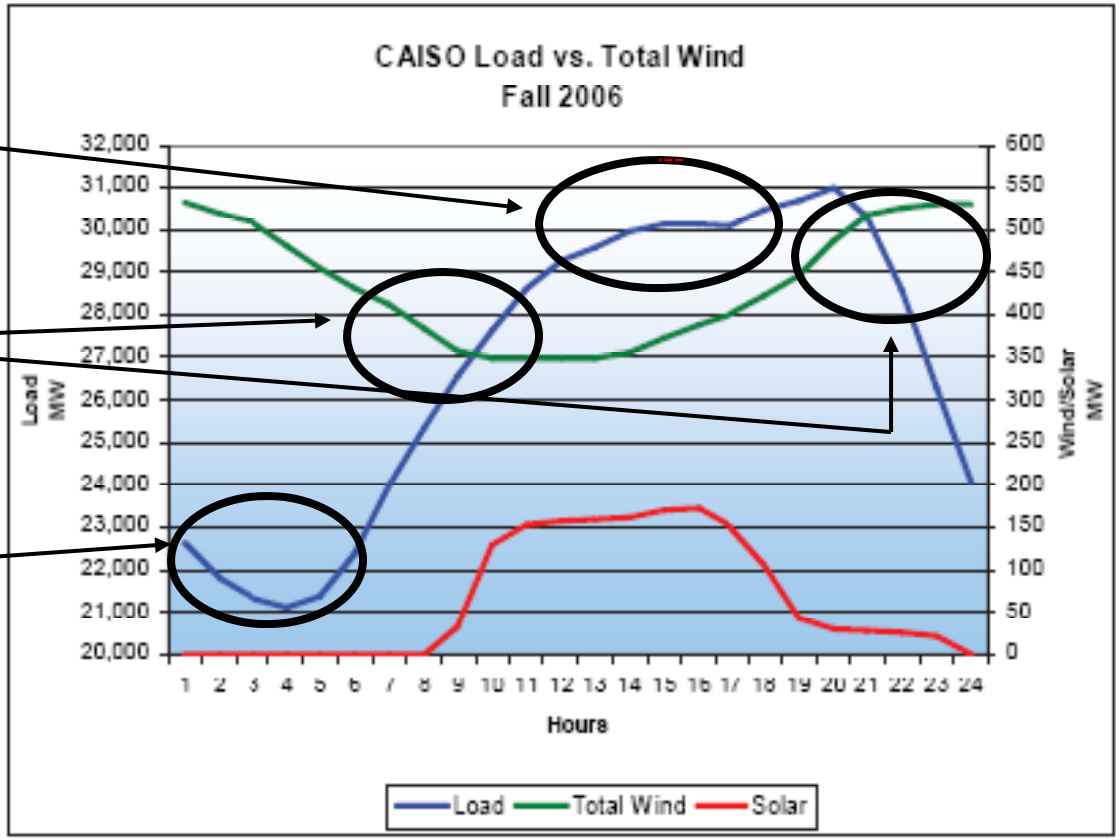


What Combination of DR Resources Needed?

Daily Peak Management

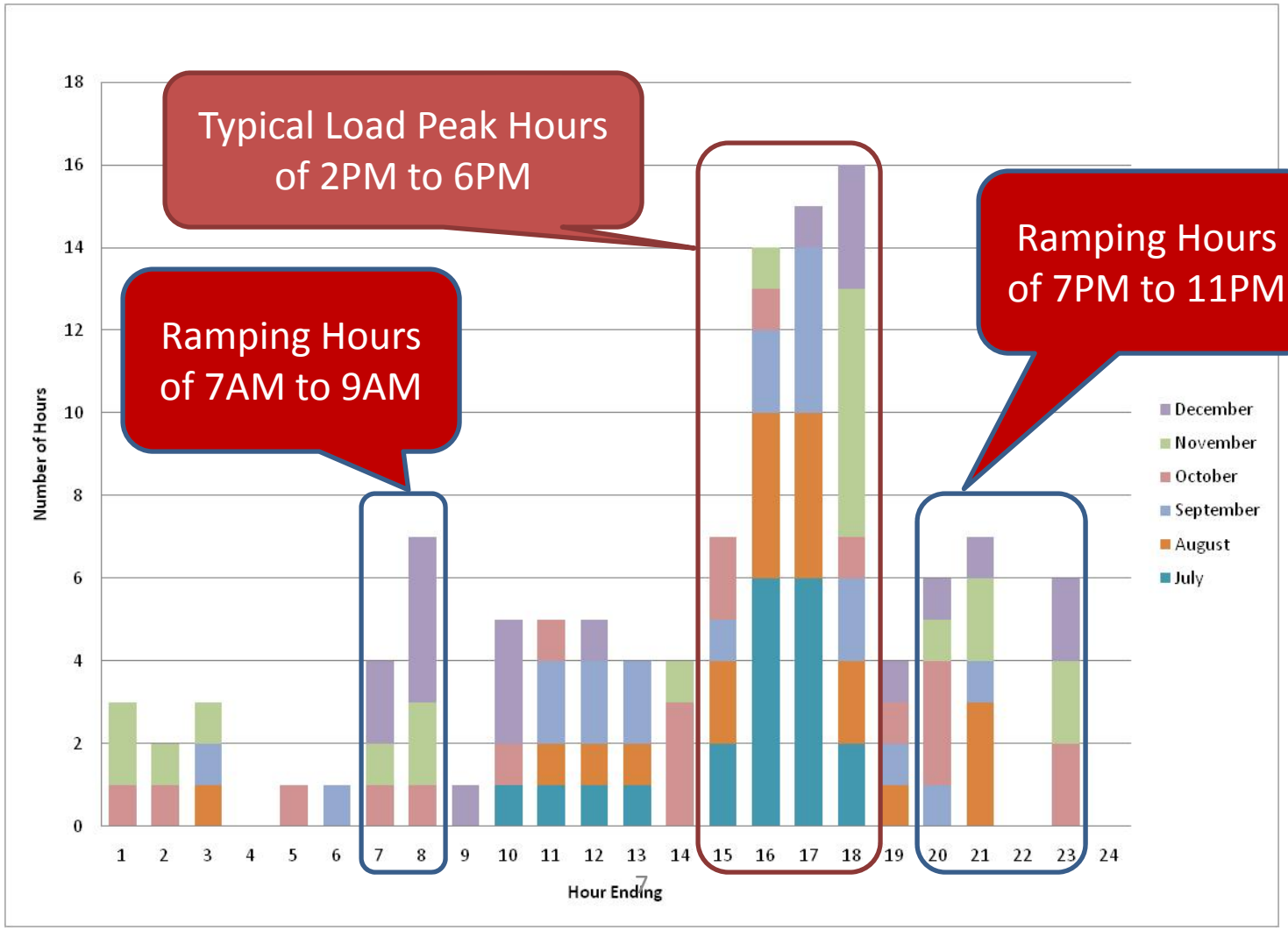
Ramp Smoothing

Shift Load to Night - Regulation Down

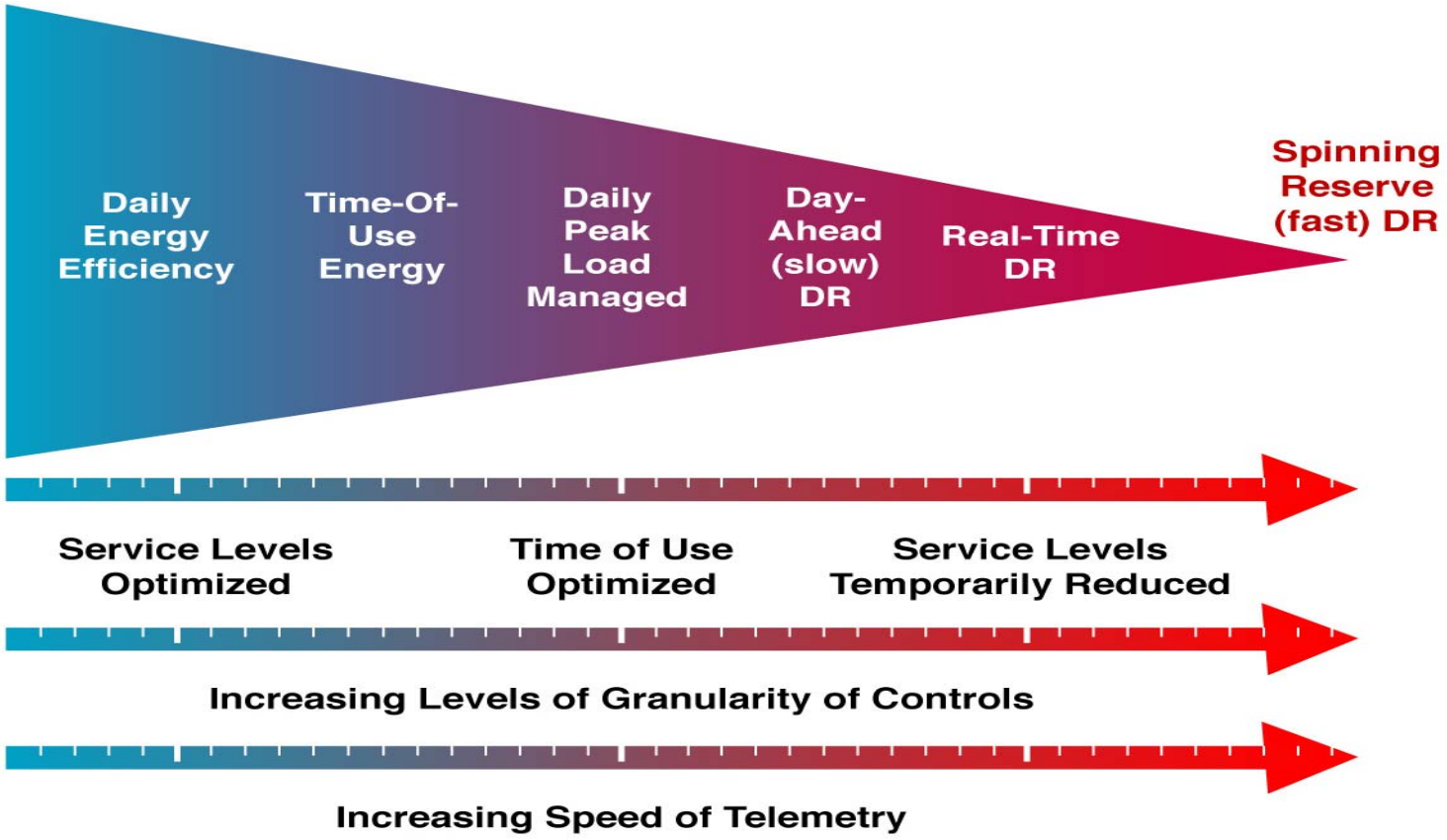


Demand Response for Variable Generation

DR has value in many other hours than 2PM to 6 PM. The "ramping" hours will be increasingly important in future years as intermittent renewables increase.



Linking Efficiency and Demand Response



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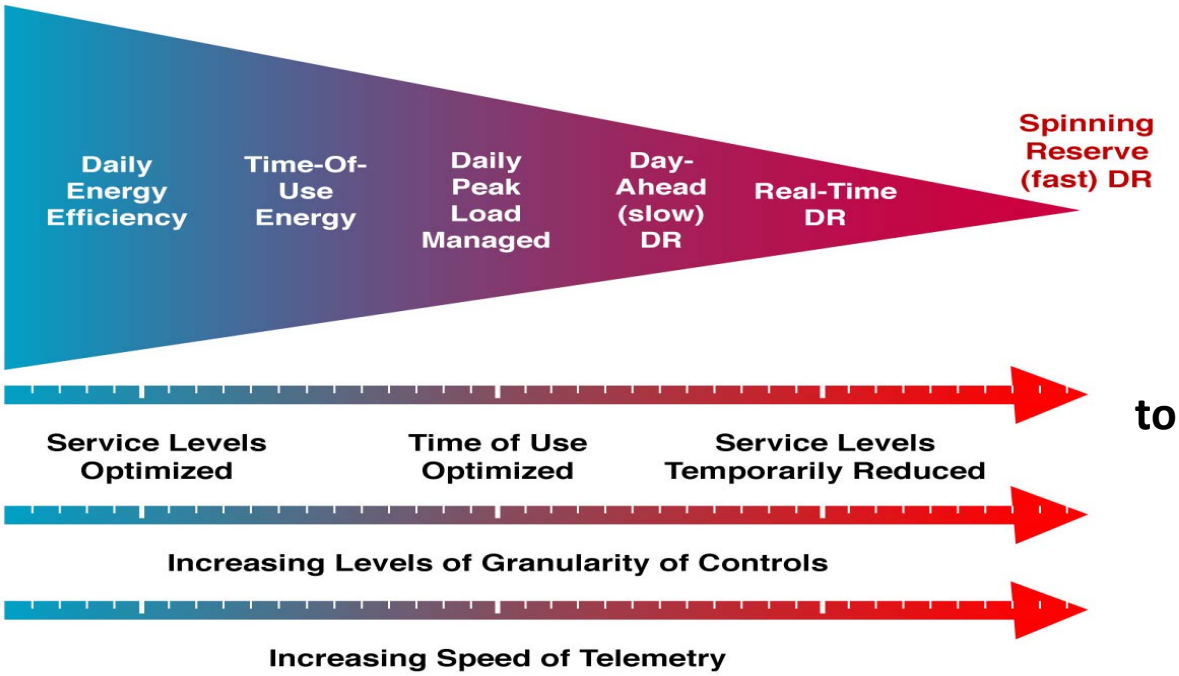
Linking Efficiency, DR and Renewables



Explore best demand side end-uses to store, shift and shed load

1. Shift load to maximize use of wind

2. Facilitate smoother ramp

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

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Facilities Type and Key End Uses for DR

Commercial

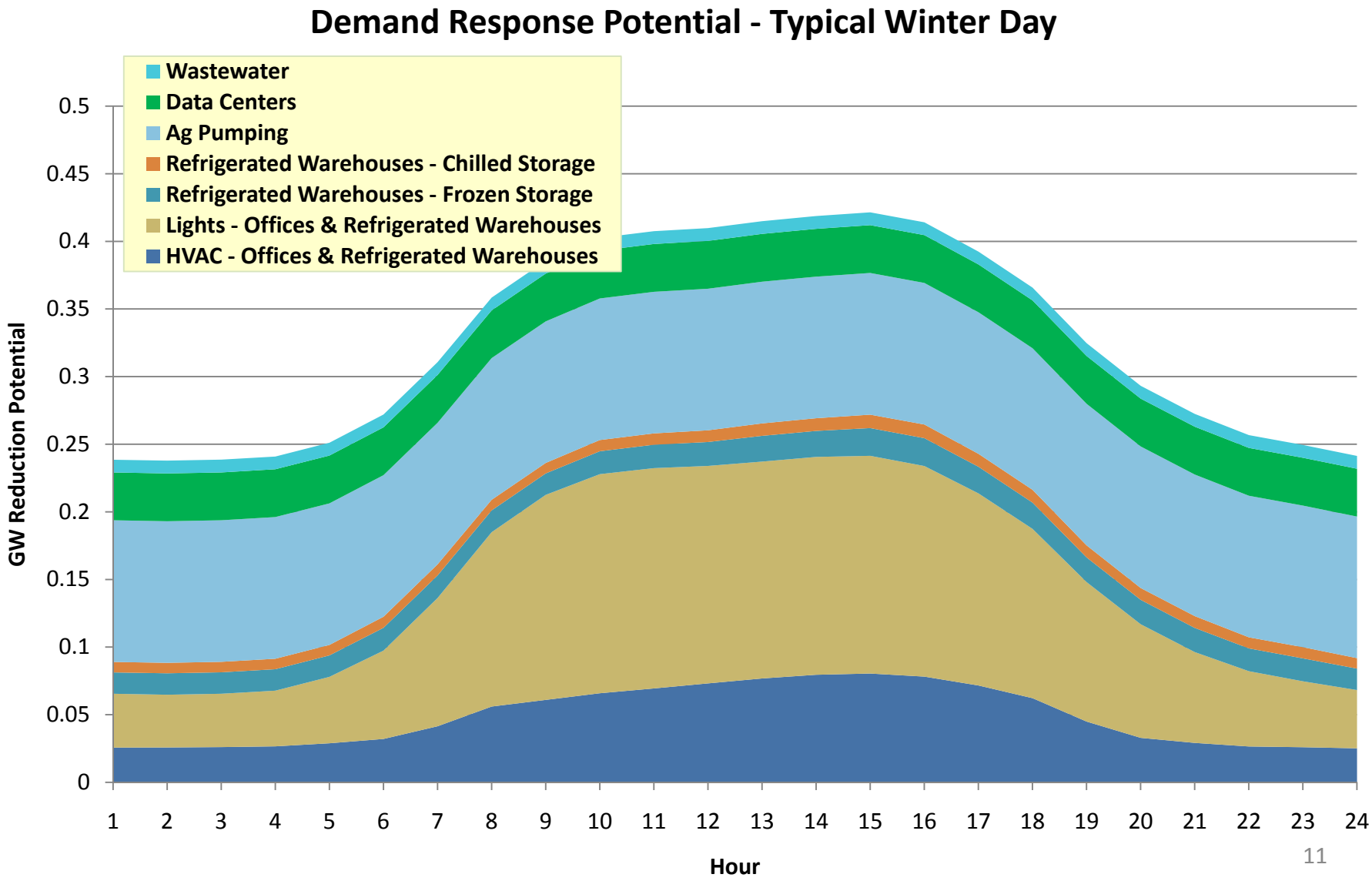
End Use	Type of Response		Response Time	
	Scaling Down	Switching Off	Scaling Down	Switching Off
HVAC	Global temperature adjustment, Decreasing duct static pressure, etc.	Turning off compressor(s), chiller(s), etc.	Less than 2-5 minutes	Seconds
Lighting	Dimming down lights	Turning off lights	Less than one minute	Seconds
Plug Loads	N/A	Turning off equipment	N/A	Seconds
Miscellaneous Electric Loads		Turning off power		Seconds

Industrial Ag & Water

DR Strategy*	Very Fast (Same hour)	Fast (Same Day)	Slow (Day Ahead)
REFRIGERATED WAREHOUSE			
Precooling		2	1
Short term shutdown	3		
WATER PUMPING			
Municipal Water Pumping	2 (w/ storage)	3	1
Agricultural Pumping		1	
WASTEWATER TREATMENT			
Storage		2	1
Over oxygenation		3	
Scheduling			1

(*Number indicates priority)

Preliminary Concepts for Continuously Dispatchable Demand Response Resources



Future Directions

- **Develop framework for DR resources to continuously link with grid:** market prices, renewable integration, ancillary services
  - Design communications and control infrastructure
  - Evaluate technical and market potential, predictability of DR
  - Ensure linkage to daily energy efficiency
- **Conduct demonstrations and field trials**
- **Link with Building Codes, require interoperable controls, minimize deployment costs**

Predictable DR
Office actual vs forecasted load,