



Workshop Overview

Energy Storage and Automated Demand Response (Auto-DR)

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Workshop Purpose



- Discuss the current status of energy storage and automated demand response (DR) technologies to support integration of renewables
- Review active energy storage and automated DR projects
- Determine major obstacles and barriers to the advancement of emerging energy storage and automated DR technologies
- Establish a technology baseline for the 2011 IEPR
- Discuss activities that need to occur prior to the Spring 2011 IEPR workshop to develop recommended policies and actions to accelerate the fielding of energy storage and automated DR products

PIER Involvement in Energy Storage and Automated DR Technologies



- PIER has a long history of interest in advancing energy storage technologies:
 - Funding field demonstrations and studies
 - Encouraging partnering and information exchange
 - Sharing the story
- PIER program funded initial research into the broad use of automation in DR technologies
 - Formed the Demand Response Research Center
 - Supported over eight years of research and field demonstrations
 - Supported the implementation of Open ADR protocol as part of national Smart Grid standards

PIER Program has a History of Evaluating the Full Range of Energy Storage Technologies

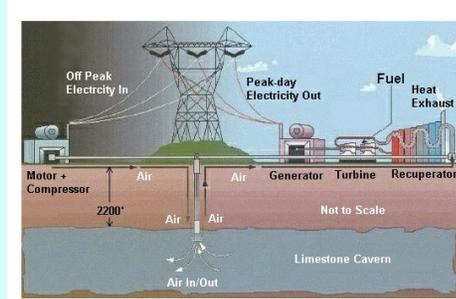


Photo Courtesy of CAES Development Company



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Photo Courtesy of Saft America

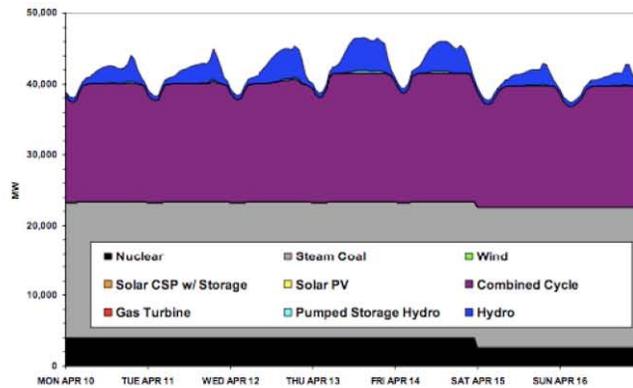


Future Challenges

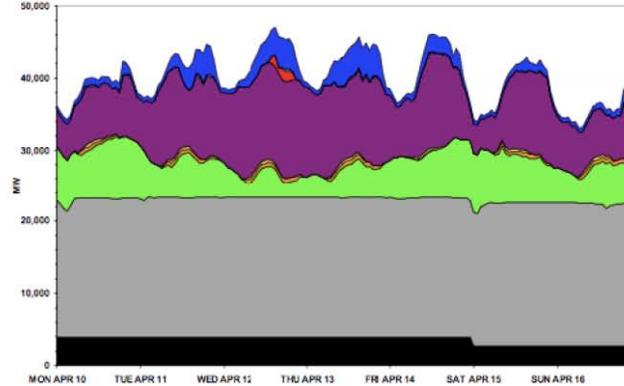


OE - Variable Generation Affects Grid Operations

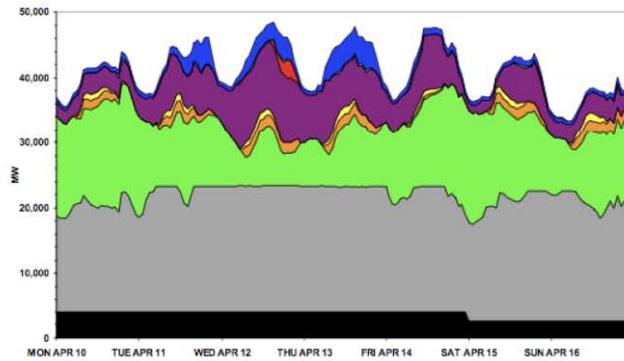
No wind



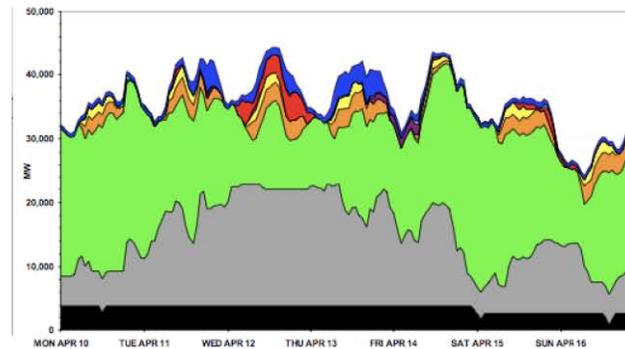
11% renewables



23% renewables



35% renewables

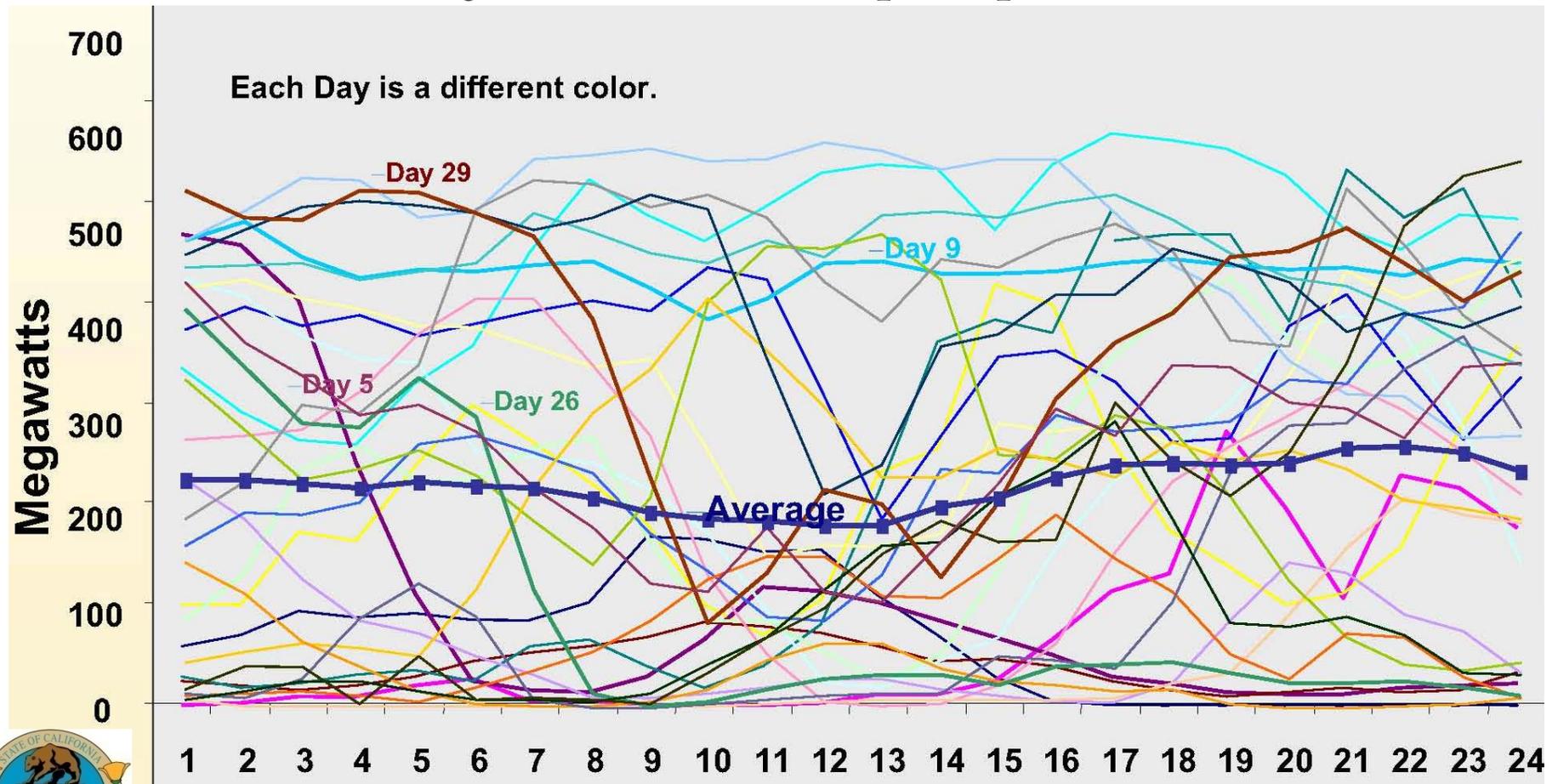


Lew et. al. "How do Wind and Solar Power Affect Grid Operations: The Western Wind and Solar Integration Study". National Renewable Energy Laboratory. (September 2009). p. 6

Wind Energy Production is a Challenge to Forecast



Wind Generation in Tehachapi – April 2005



Source: CAISO, *Integration of Renewable Energy Presentation*,
Dave Hawkins and Clyde Loutan, *PSERC Presentation*, October 2, 2007



2013 Solar Ramps will be an issue to manage

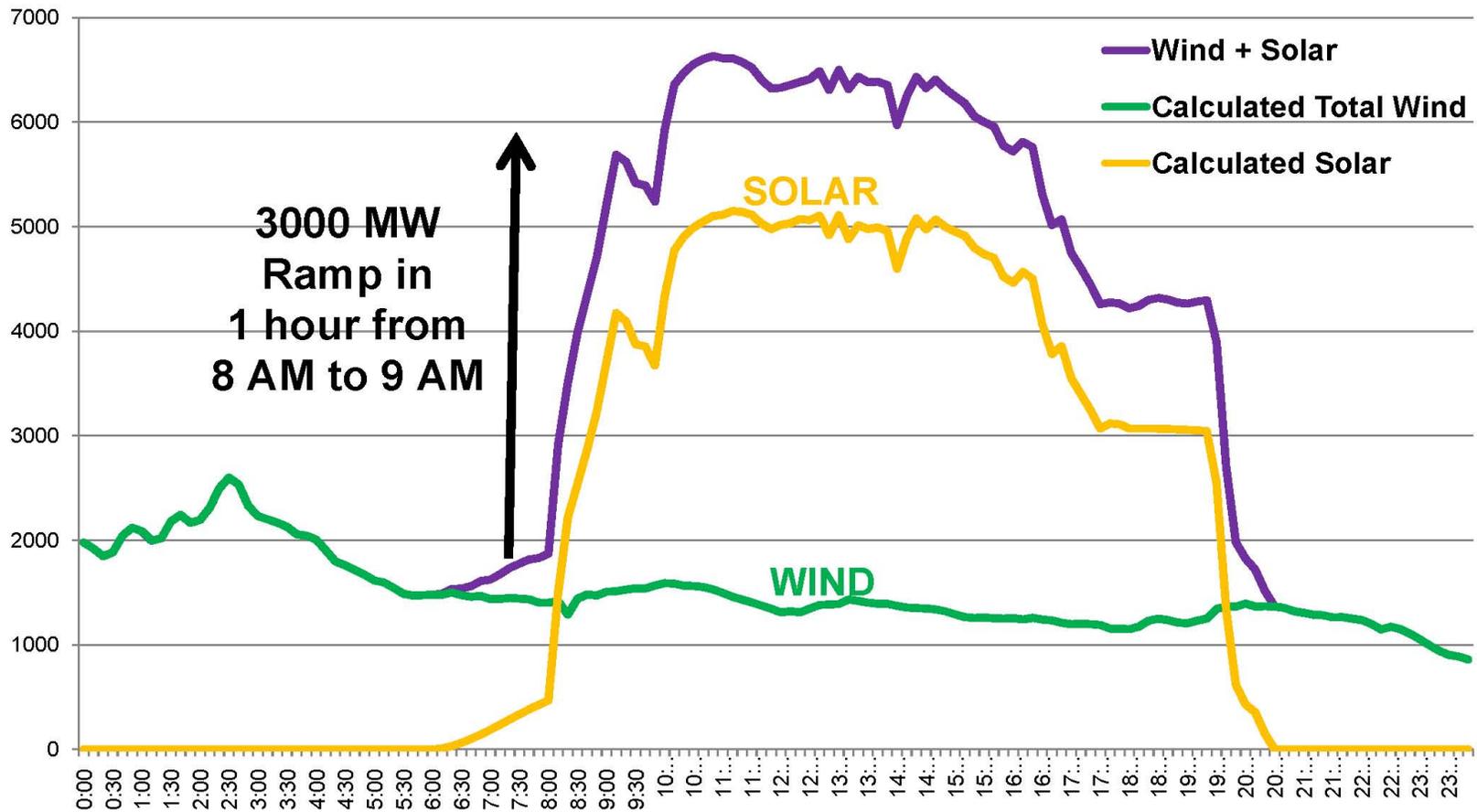


Chart based on March 2010 actual data and escalated to amount of renewables expected in 2013

Energy Storage Technologies



- **Pumped Hydro**
- **Compressed Air Energy Storage (CAES)**
- **Flywheels**
- **Batteries**
- **Super-Capacitors (SuperCaps)**
- **Superconducting Magnetics**
- **Thermal Storage**
- **Fuel Cells (reversible)**
- **Hydrogen Storage**

Upcoming PIER Funded Research Project

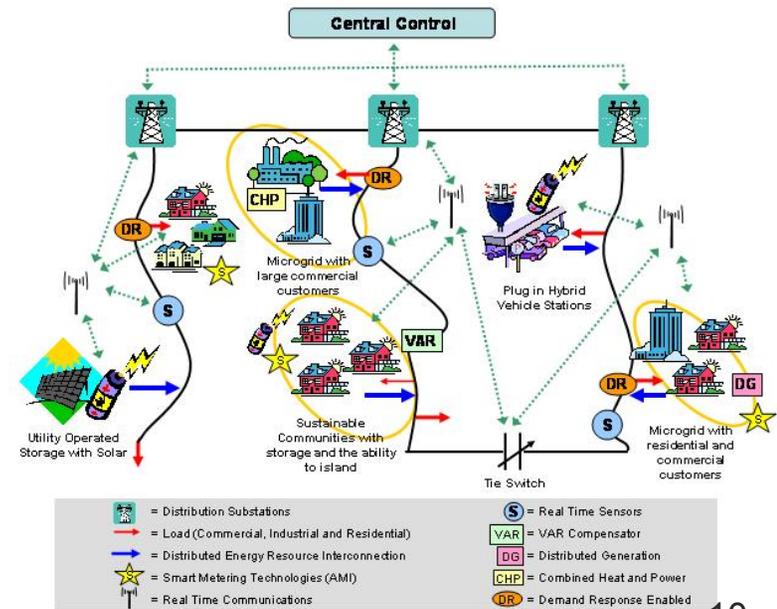
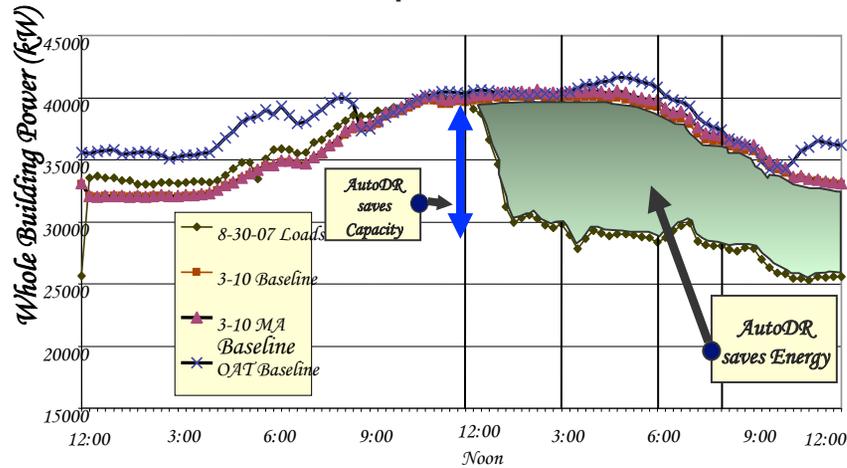


- Develop an initial California vision for energy storage for 2020
- Prime Contractor is the California Institute for Energy and the Environment (CIEE)
- 6 month effort
- Help understand the role of energy storage in California
 - Look at full range of applications
 - Help CPUC with AB 2514 implementation
 - Share results in Spring 2011 IEPR workshop

Integration of Demand Response



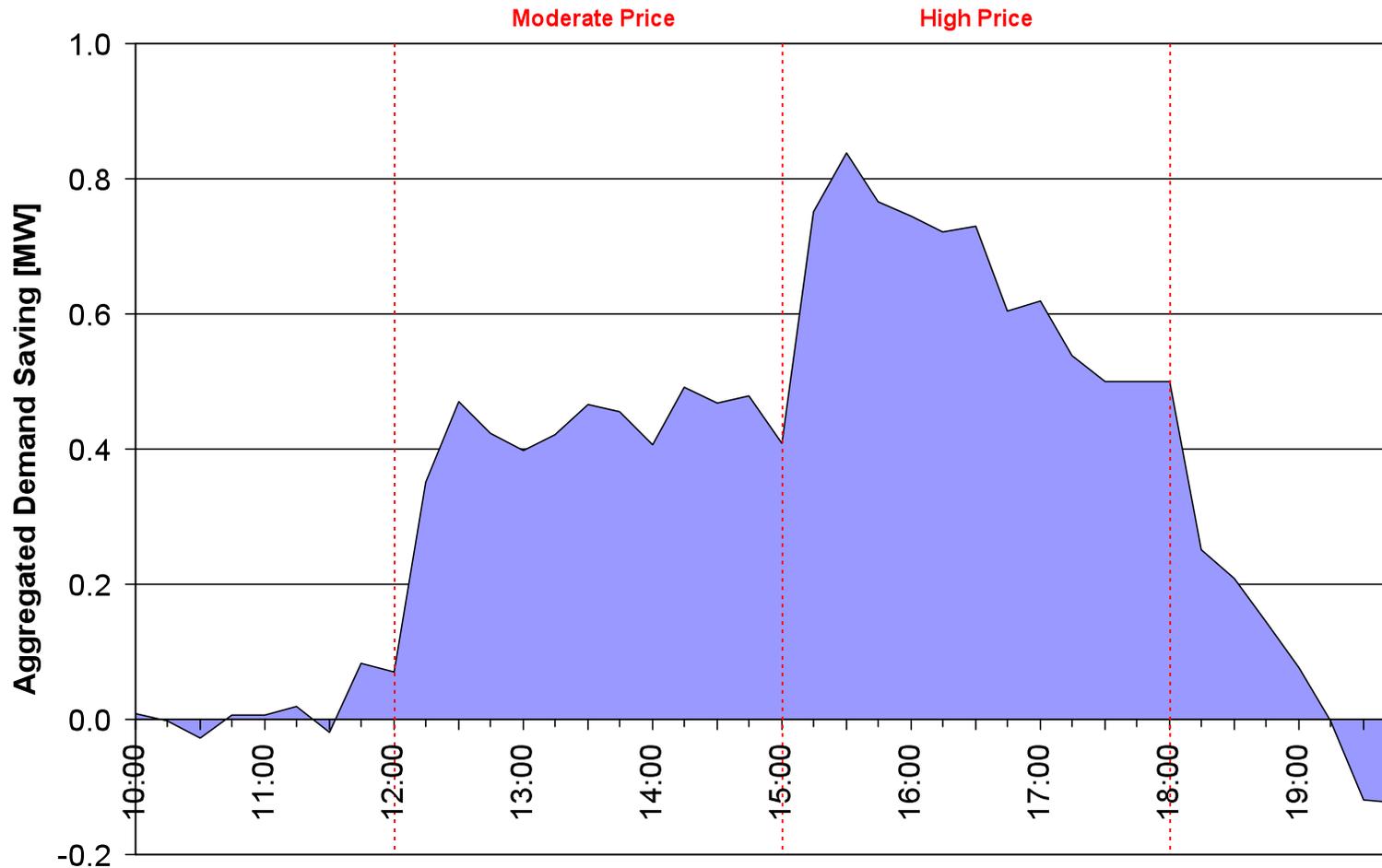
PG&E AutoDR Test Day – All AutoDR Participants – 8/30/07



Automated DR Potential

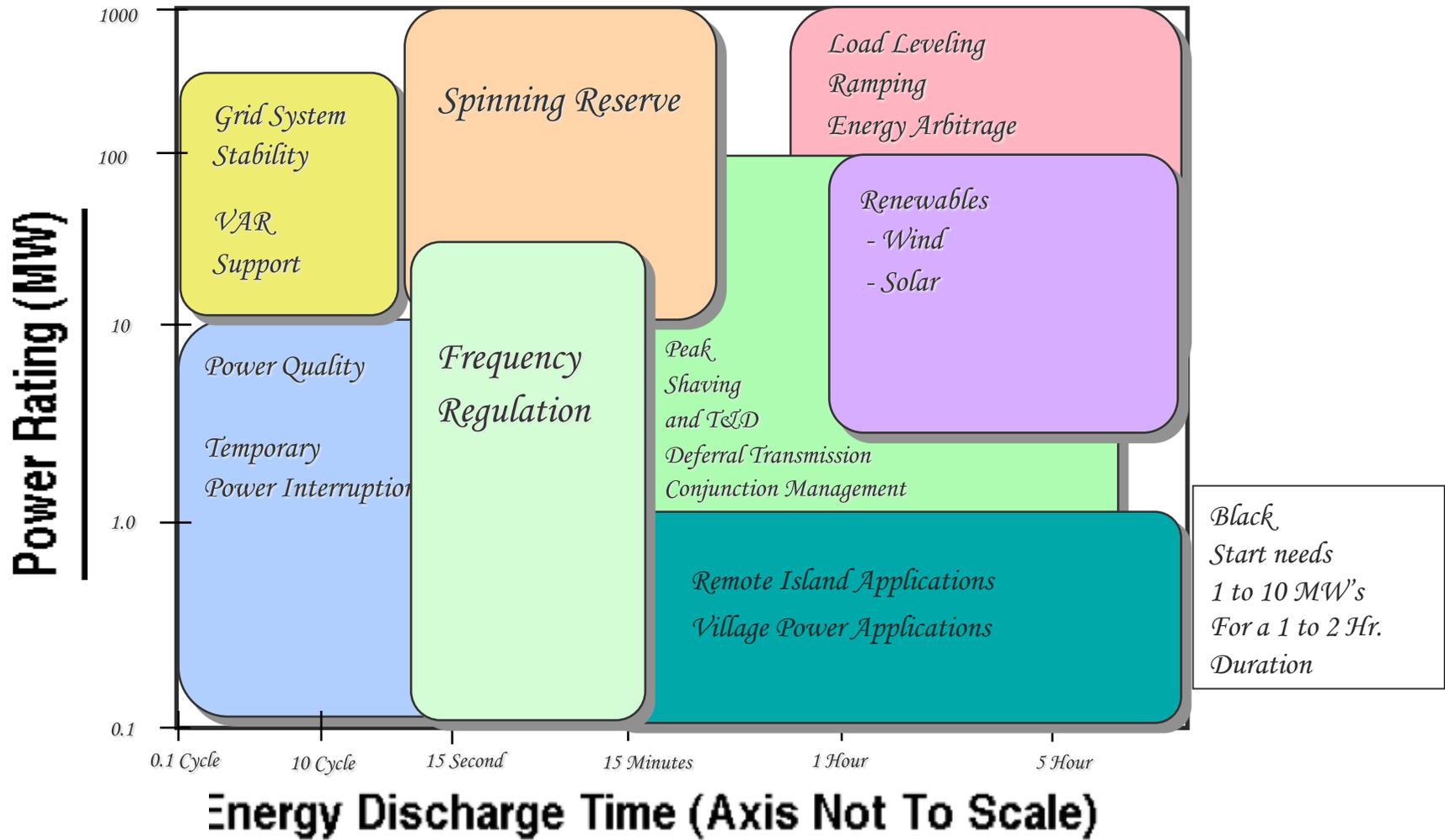


Aggregated Demand Saving, 7/24/2006 (Max OAT: 103 °F)
7 Buildings (Zone 2), Total 0.75 million ft²



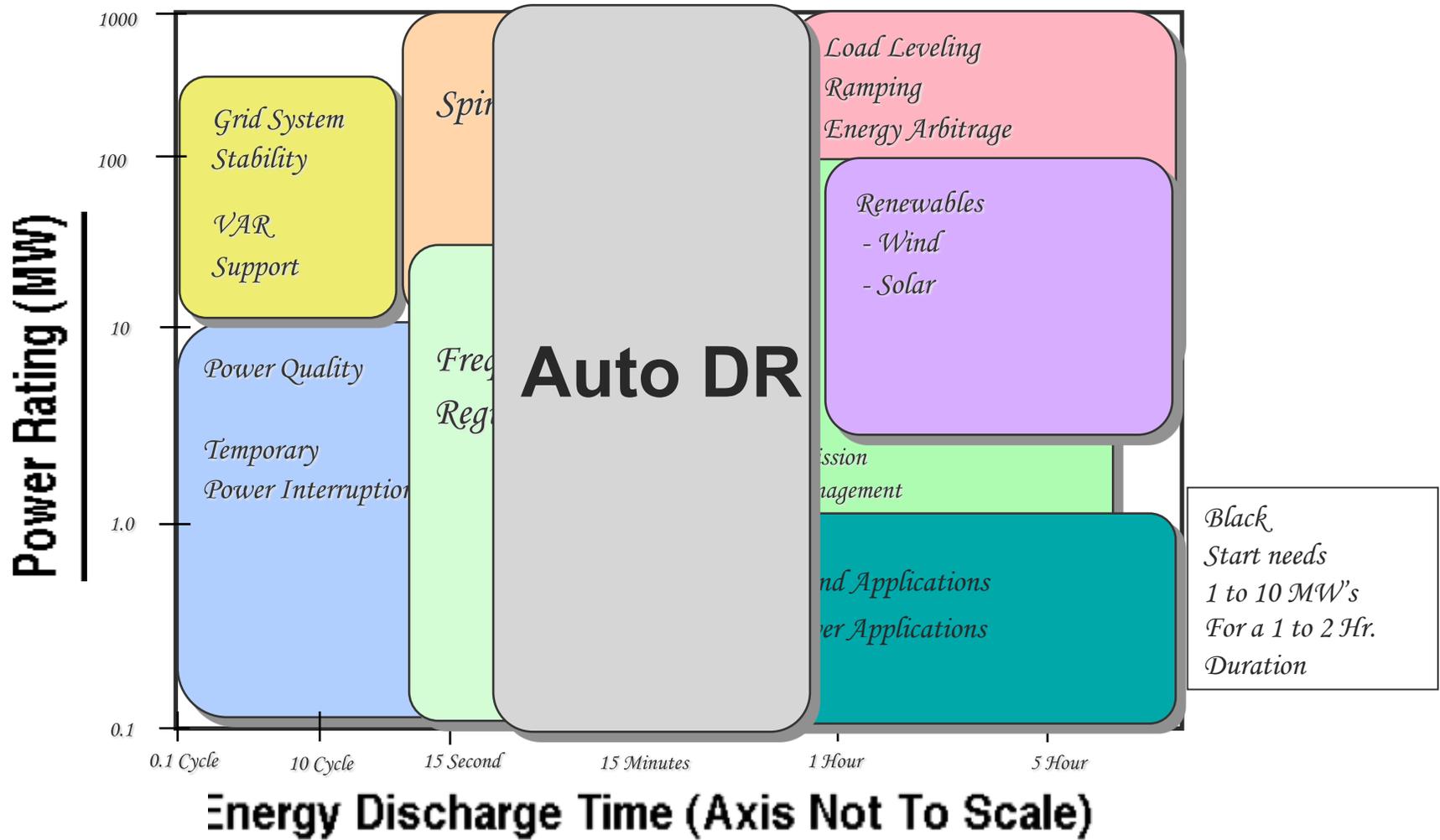
Electric Energy Storage Applications

(All Boundaries Of Regions Displayed Are Approximate)



Auto DR Grid Service Application Potential

(All Boundaries Of Regions Displayed Are Approximate)



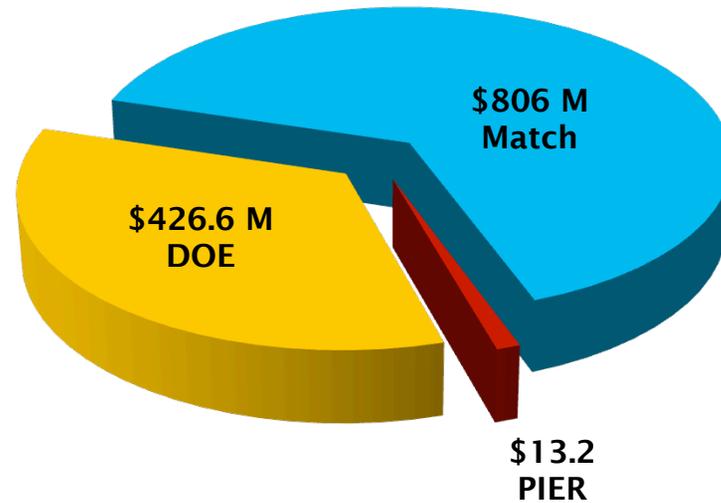
Smart Grid ARRA Projects



15 California Based Projects Totaling \$1.25 Billion

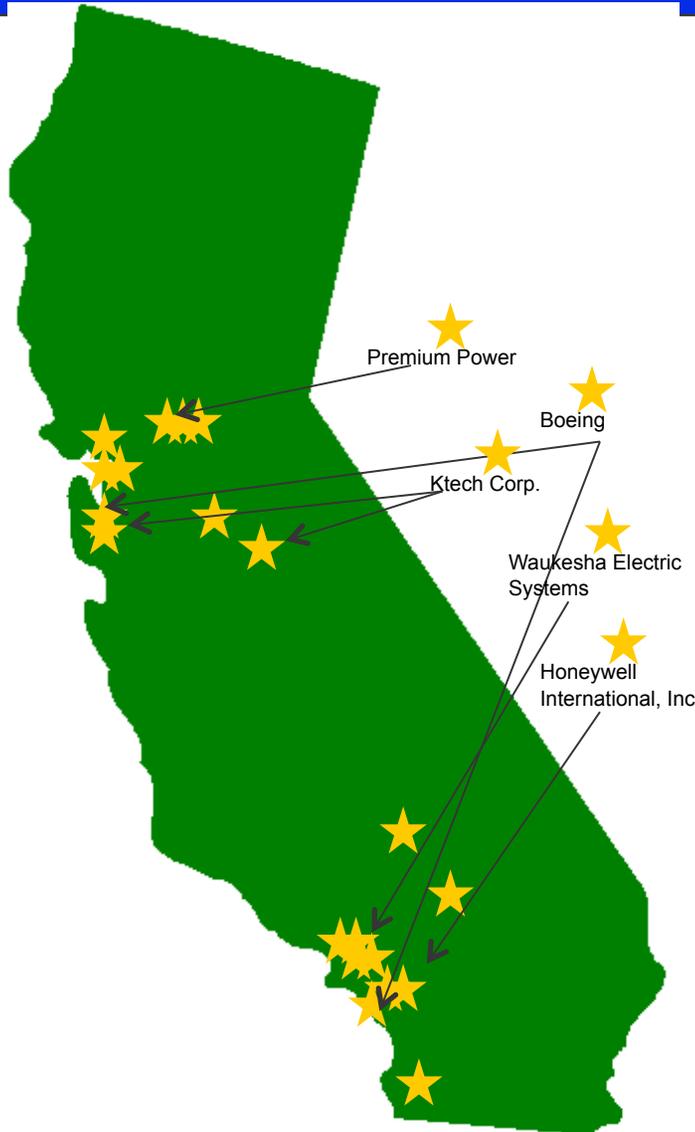
Why PIER Provided Cost-Share For ARRA

- Without PIER funding DOE would not award *(DOE recognizes CA's leadership in Smart Grid)*
- Early Warning To Identify How Smart Grid Is Developing
- Ensure Consistency Among California Projects
- One Smart Grid for California *(Energy Commission Is The Common Participant For All Projects)*



- Smart Meters
- Communication
- Storage
- Consumer Behavior
- Standards
- Grid Security
- Phasors
- PHEV
- Demand Response
- HAN

ARRA Smart Grid in California



Total Project Value to CA - \$1.3 Billion

- City of Glendale Water & Power
- Modesto Irrigation District
- Burbank Water & Power
- City of Anaheim
- Electric Power Group (WECC sub-contractor)
- Pacific Gas & Electric (WECC sub-contractor)
- Sacramento Municipal Utility District
- San Diego Gas & Electric
- Honeywell International, Inc. (Headquarters in MA, work being done in Southern CA)
- Los Angeles Department of Water & Power
- Southern California Edison
- Boeing (Headquarters in MO, work being done in Sunnyvale and Huntington Beach, CA)
- Waukesha Electric Systems (Headquarters in WI, work being done in Irvine, CA)
- Primus Power
- SEEO Inc.
- Southern California Edison
- Pacific Gas & Electric
- Amber Kinetics
- Ktech Corp. (Headquarters in NM, work being done in Sunnyvale and Snelling, CA)
- Sacramento Municipal Utility District (sub-contractor to Premium Power, Headquarters in MA)



Workshop Agenda Review

Follow-up Questions



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