



SMART GRID RESEARCH, DEVELOPMENT & DEMONSTRATION ACTIVITIES

DOCKET
09-IEP-1G

DATE _____

RECD. May 12 2009

Pedro Gomez

Energy Systems Integration
California Energy Commission

pgomez@energy.state.ca.us
(916) 653-4278

PIER Smart Grid Research



Energy Systems Integration

- Transmission
- Distribution
- Demand Response
- DER Integration
- Grid Security
- Energy Storage
- Grid Infrastructure Integration
- Intelligent Agent integration and application
- Advanced communications and control

Buildings--End Use Efficiency

IAW—End Use Efficiency

Renewables

Environmentally Preferred Advanced Generation

Transportation

Environmental

Public Interest Research Program

ESI Goal



Through Research:

Facilitate the Development and Integration of
Hardware and Software Technologies to
Deploy the Smart Grid for California

ESI - What We Do



- Identify System Limitations
- Confirm Limitations Through Stakeholder Forums
- Fund Public Interest Research Projects to Improve the Electric System
- Integration of New Technology for Smart Grid
- Provide Ratepayer Benefits and Support California Energy Policies

ESI - Budget



- Annual Budget = \$10M
- Active Projects = \$136M
- Leverage Funding to Maximize Opportunity

Research In All Areas



Transmission



Substation



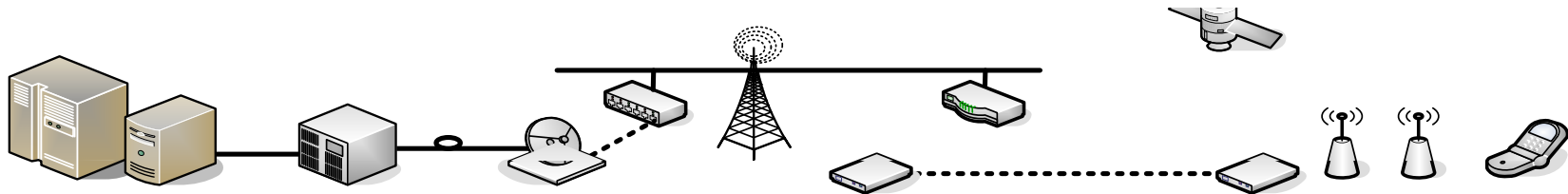
Distribution



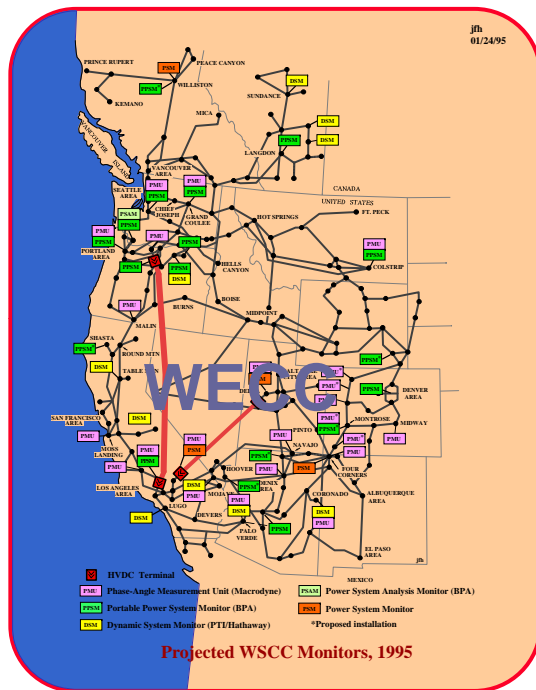
Demand Response



Communication Enabled Power Infrastructure

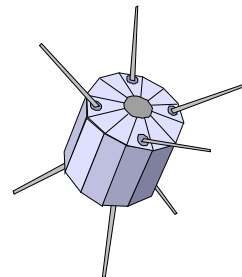


Synchrophasor Measurement – The Heart of the Smart Grid Transmission

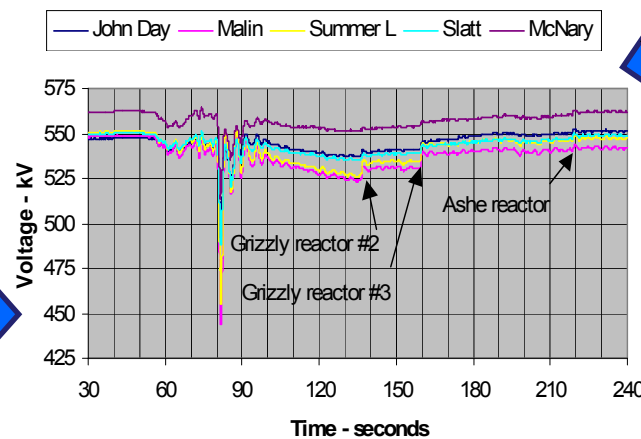
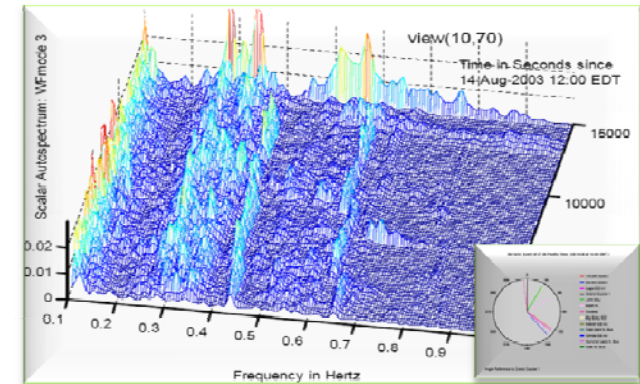


**PMUs (Phasor
Measurement Units)**

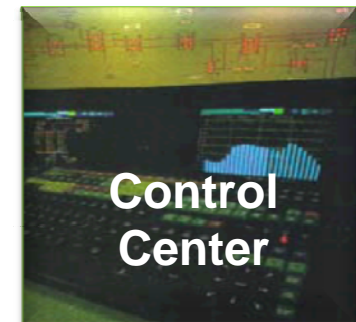
GPS Satellite



Time-Stamp



Time Synchronous Data

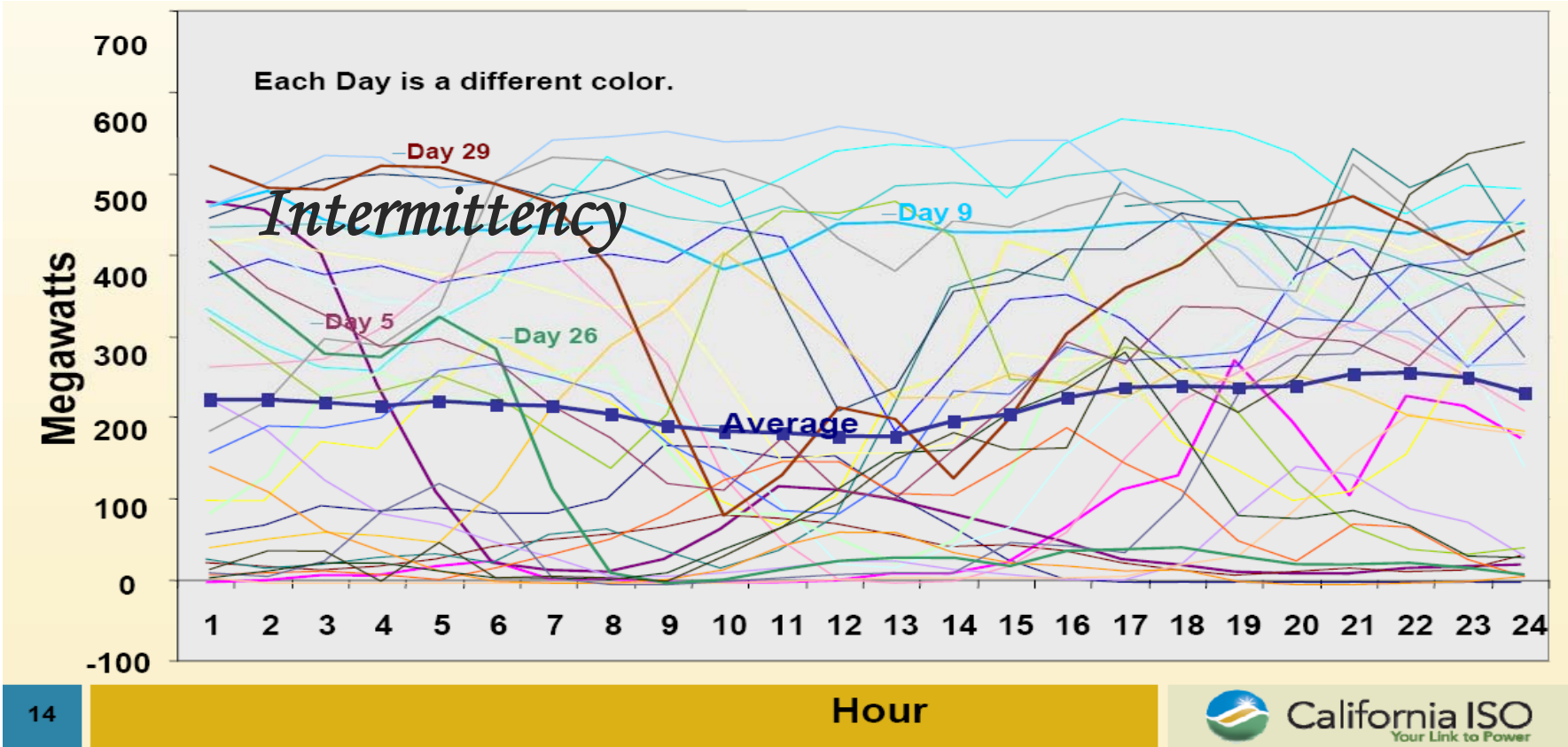


**Control
Center**
**Useful
Real-Time
Information**

Accommodating Unique Renewable (Wind) Generator Behaviors



Tehachapi Wind Generation - April 2005



Storage: Compressed Air, Flywheel, Battery, Pumped-Hydro

Energy Storage Technologies



Zinc Bromide Battery

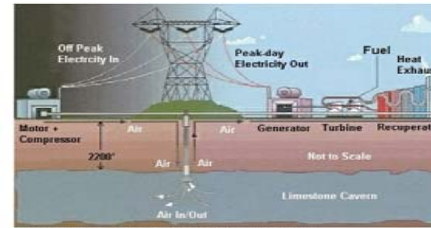


Photo Courtesy of CAES Development Company

Compressed Air



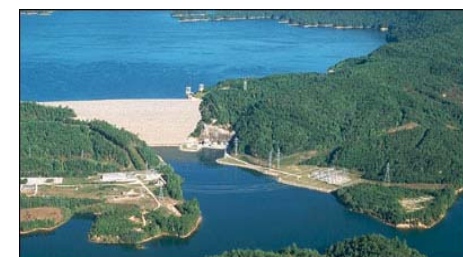
Compressed Air



Sodium Sulfur Battery



Residential Storage



Pumped-Hydro



Lead Acid Battery



Photo Courtesy of Saft America

Lithium Ion Battery

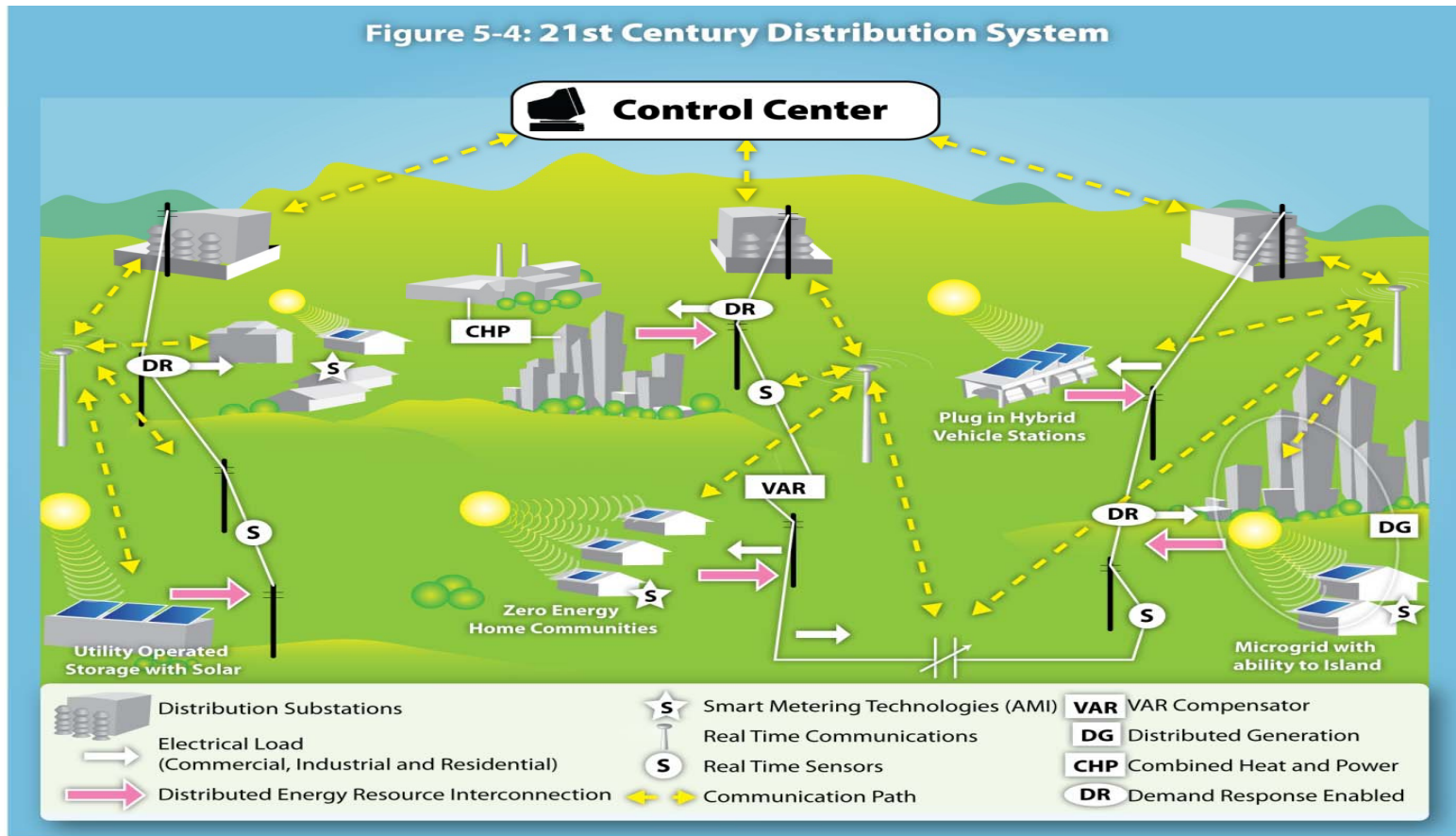


Flywheel

Utility Grid of the Future (Smart Grid)



Figure 5-4: 21st Century Distribution System



Grid of the future will allow for two-way communication and power flow



Demand Response Automation

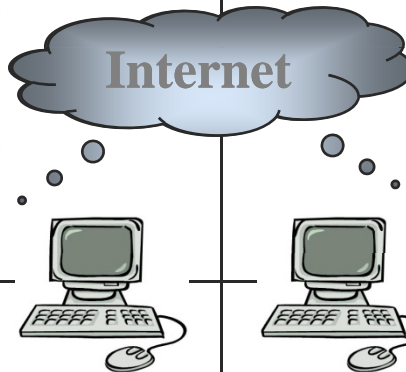
Demand Response Automation For All Customer Classes

Communicating Thermostat



Demand Response Automation Client

Energy
Management
System



Demand Response Automation Client

Energy
Management
System

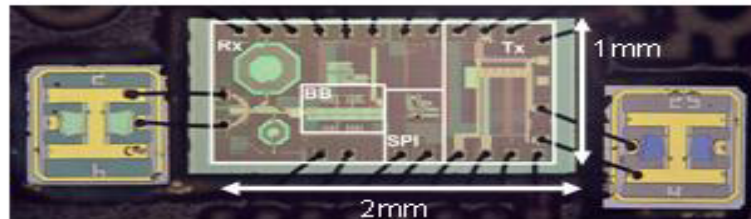


Emerging Technologies-- Communications



Recent Enabling Technology Development Research Projects

Smaller, cheaper radio components...



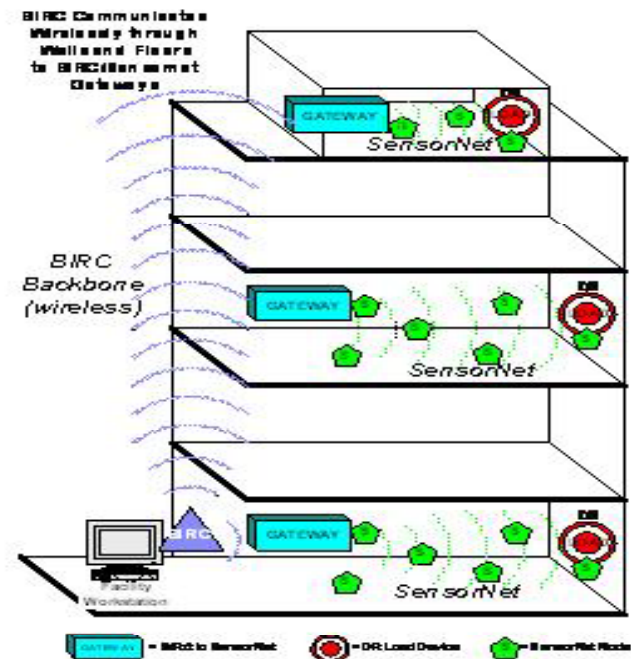
... leads to smaller, cheaper DR enabling technologies



Sensors Continue to Get Smaller

Barrier Immune Radio Communications

Studying how different communication signals propagate through different building materials.



Testing for Power Level and Frequencies

Upcoming Smart Grid Activities



PIER Request for Proposal:

- Defining the Pathway to the California Smart Grid of 2020
 - One Contract from Utility Perspective for up to \$500,000
 - One Contract from Industry Perspective for up to \$500,000

Upcoming Smart Grid Activities



PIER Funded RD&D Activities:

- White Paper on how Smart Grid technologies will make electricity energy storage more useful in meeting California's goals
- Micro-Grid demonstrations of Smart Grid technologies
- White Paper on defining the Smart Grid standards, codes and protocols
- White Paper on the Smart Grid technologies that will accelerate the fielding or increase the penetration of renewables in California

Follow-up Questions



Pedro Gomez

Energy Systems Integration
California Energy Commission

(916) 653-4278
pgomez@energy.state.ca.us