



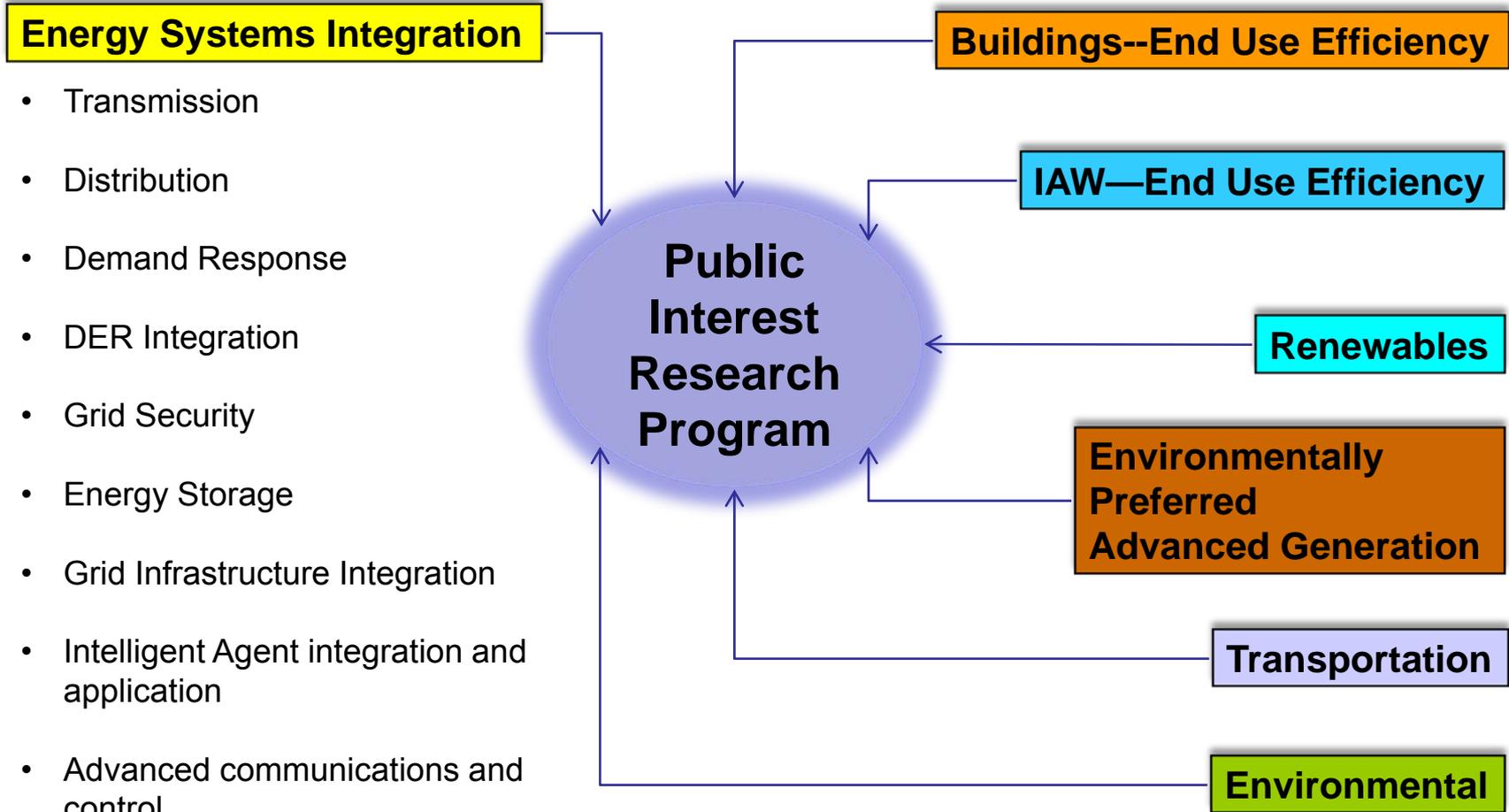
SMART GRID RESEARCH, DEVELOPMENT & DEMONSTRATION ACTIVITIES

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PIER ESI Research





Through Research:

- To Facilitate the Development and Integration of Hardware and Software Technologies That Support California's Energy Policy and Lead us to a Smart Grid

ESI - What We Do



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

ESI - Budget



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

Research In All Areas



Transmission



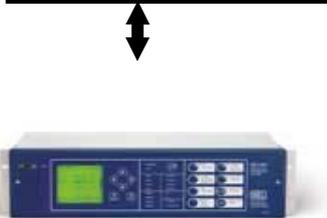
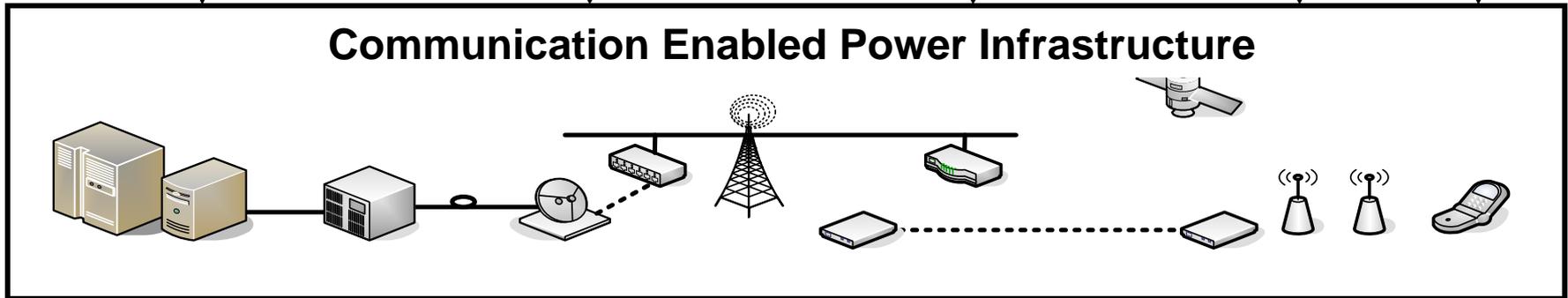
Substation



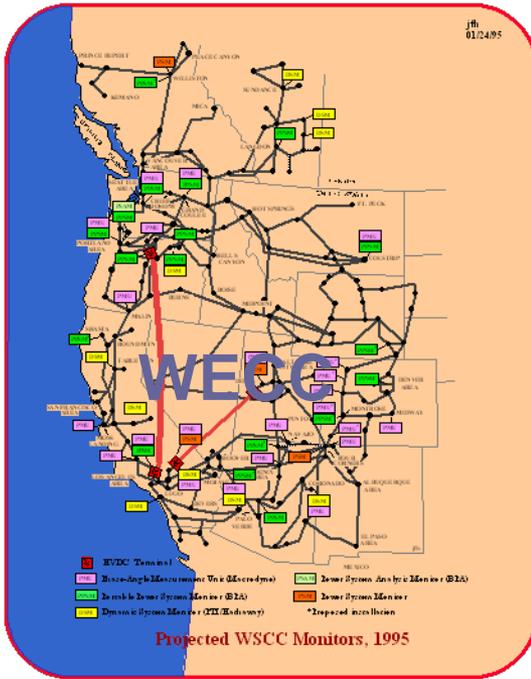
Distribution



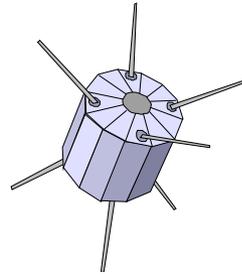
Demand Response



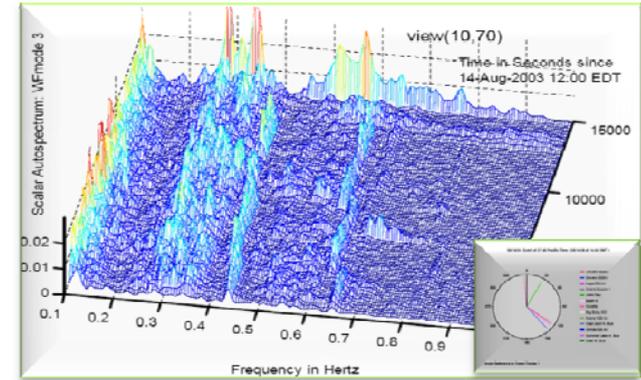
Synchrophasor Measurement – The Heart of the Smart Grid Transmission



GPS Satellite



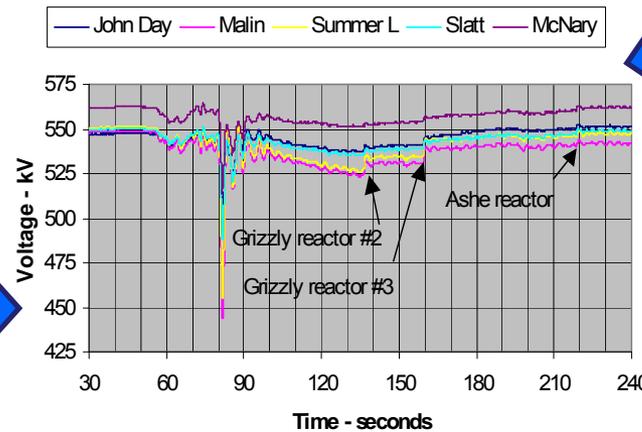
Time-Stamp



Data



Data



Time Synchronous Data



Control Center

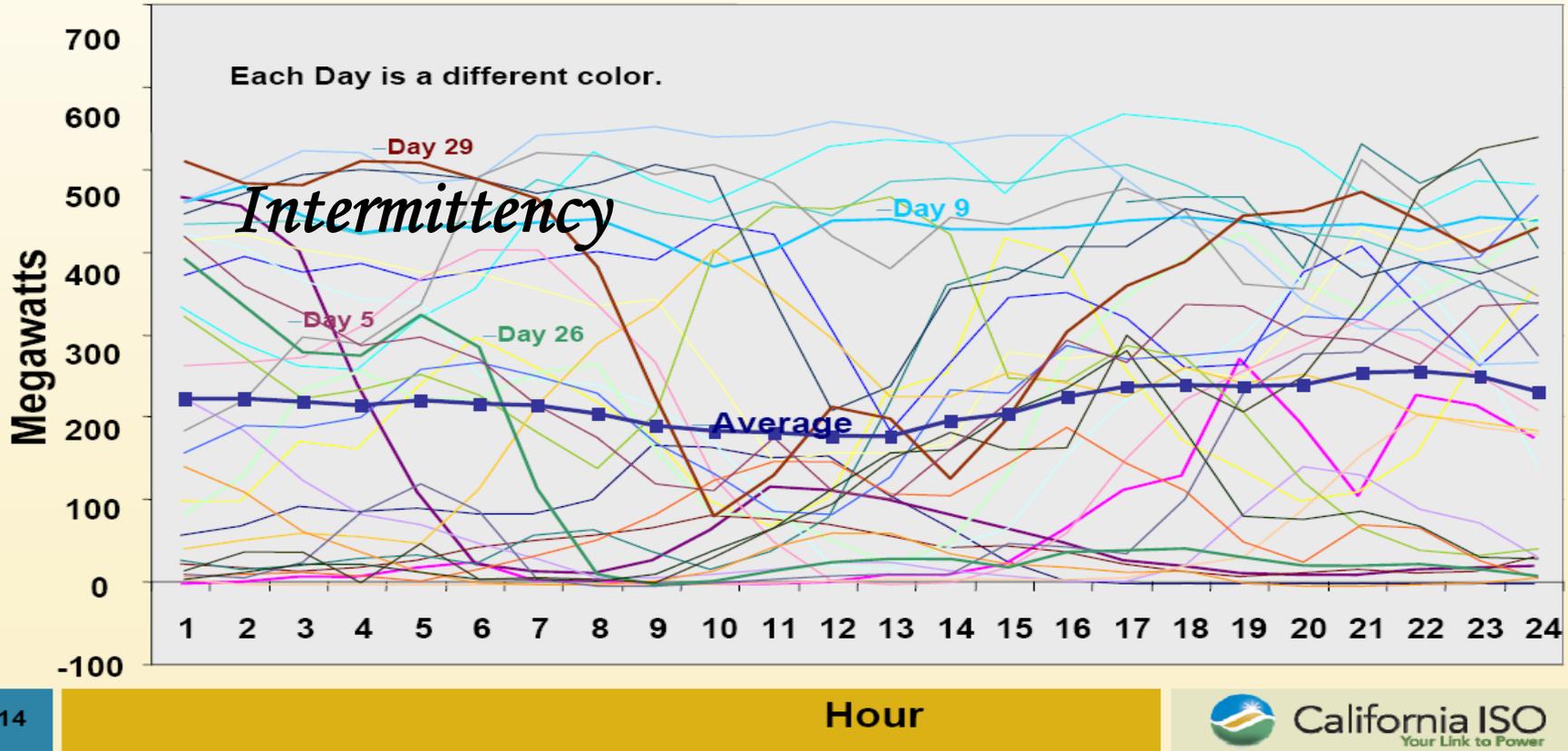
Useful Real-Time Information

PMUs (Phasor Measurement Units)

Accommodating Unique Renewable (Wind) Generator Behaviors



Tehachapi Wind Generation - April 2005



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

Energy Storage Technologies



Zinc Bromide Battery

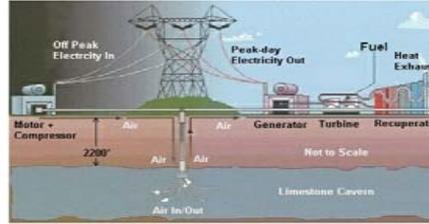


Photo Courtesy of CAES Development Company

Compressed Air



Compressed Air



Sodium Sulfur Battery



Residential Storage



Pumped-Hydro



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Lead Acid Battery



Photo Courtesy of Saft America

Lithium Ion Battery

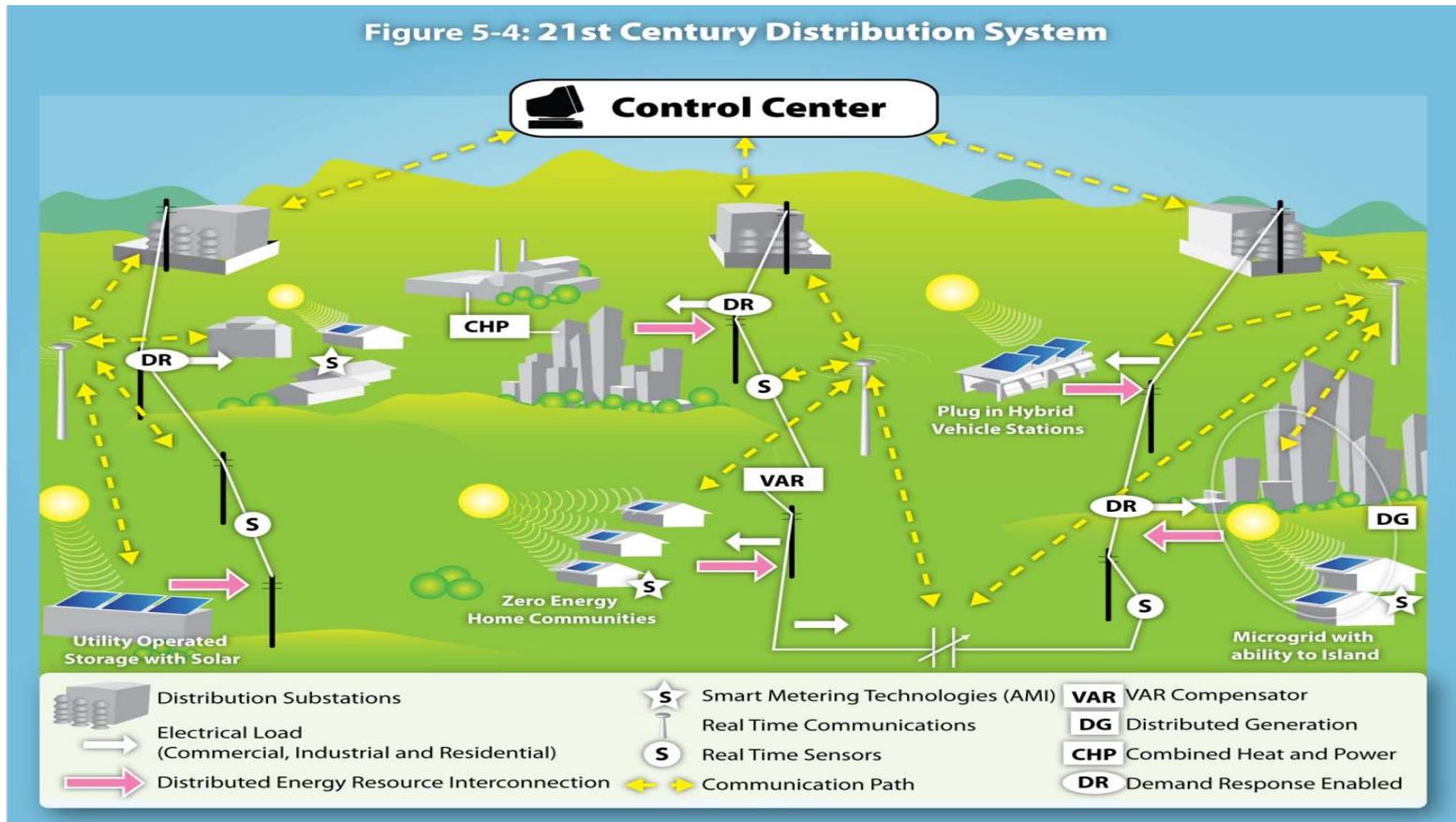


Flywheel

Utility Grid of the Future (Smart Grid)



Figure 5-4: 21st Century Distribution System

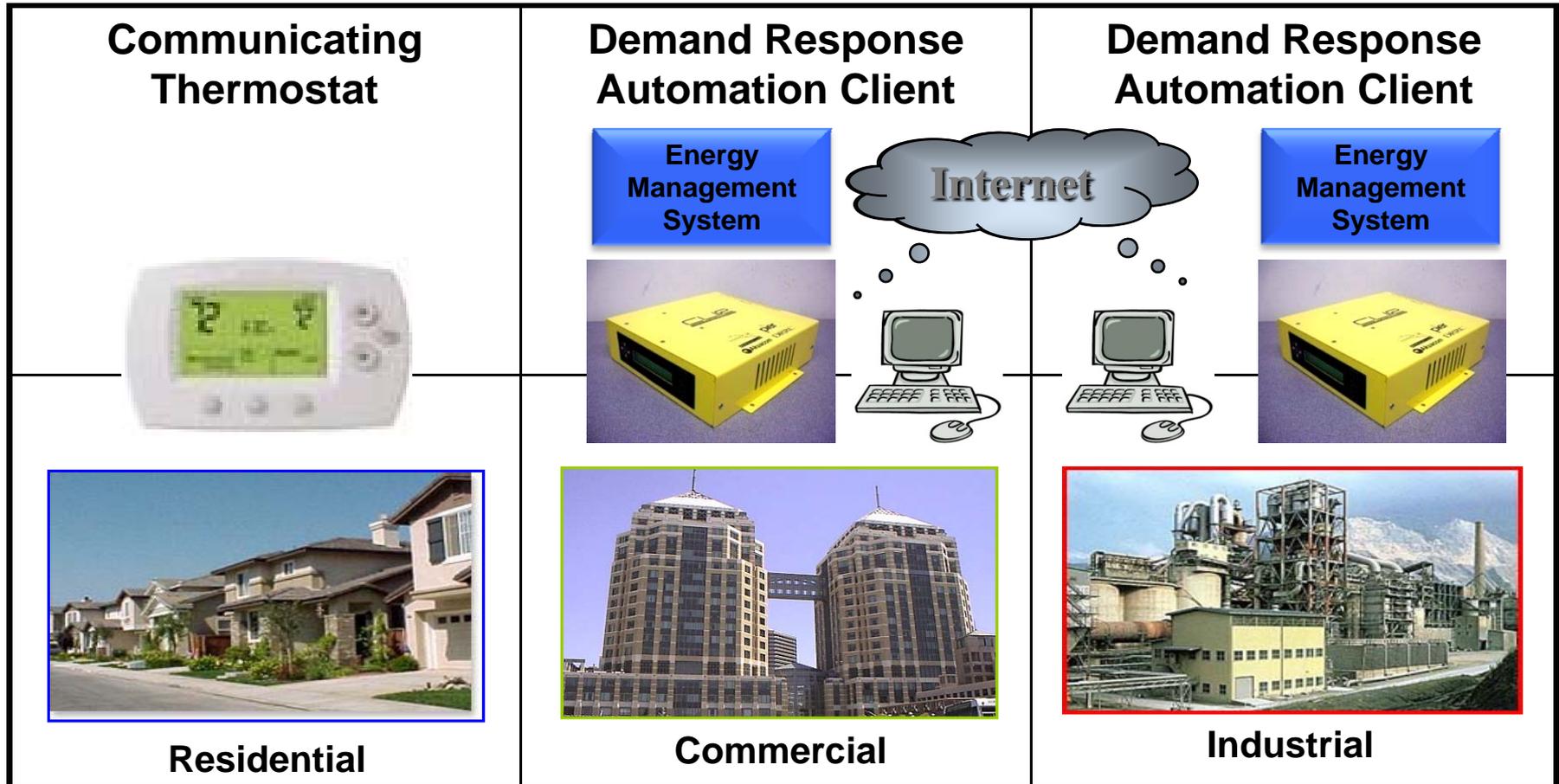


Grid of the future will allow for two-way communication and power flow

Demand Response Automation



Demand Response Automation For All Customer Classes

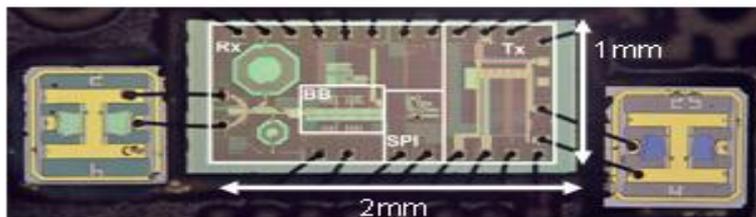


Emerging Technologies-- Communications



Recent Enabling Technology Development Research Projects

Smaller, cheaper radio components...



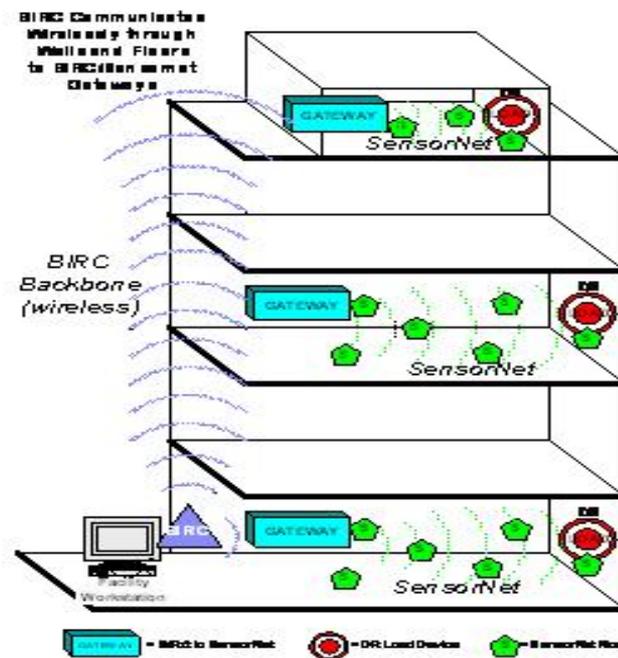
... leads to smaller, cheaper DR enabling technologies



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



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