

## Smart Grid: The View from California

Chris King

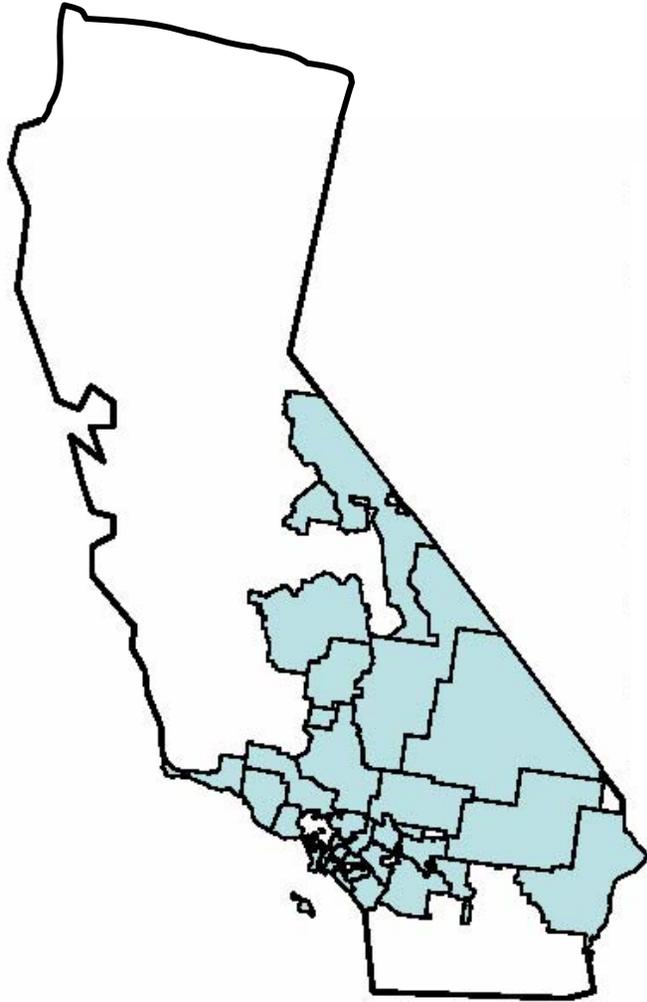
Chief Strategy Officer

eMeter Corporation



- Company Background & Qualifications
  - HQ in San Mateo, CA
    - > 100 Employees and growing
  - Executive Team - nearly two decades experience in AMI
  - Leader in Advanced Metering Information Systems
    - Meter Data Management (MDM)
    - Integration platform linking AMI systems to utility legacy systems
    - AMI Business Process Management (BPM)
  - 100% dedicated to MDMS software solutions
- Our Business
  - EnergyIP™ software supporting AMI and Demand Response
    - License
    - Implementation services
    - Software support and maintenance services
  - AMI/Meter vendor-neutral
  - Embrace system integrators and other business partners

- Three major IOUs totaling 12 million electric meters
  - PG&E
  - SDG&E
  - SCE
- AMI rollouts
  - PG&E and SDG&E approved by CPUC, including cost recovery
  - SCE has signed settlement with intervenors and is awaiting CPUC approval
- SmartGrid
  - All three utilities are interested
  - SCE has defined the vision in the greatest detail
  - eMeter is part of SCE's implementation (providing MDM and related functionality)



- Founded 1897
- 50,000 square miles
- 4.8 million customers
- 22,000 MW peak demand
- 4,100 distribution circuits
- 48,000 switches
- 12,000 capacitor banks
- 680,000 distribution transformers

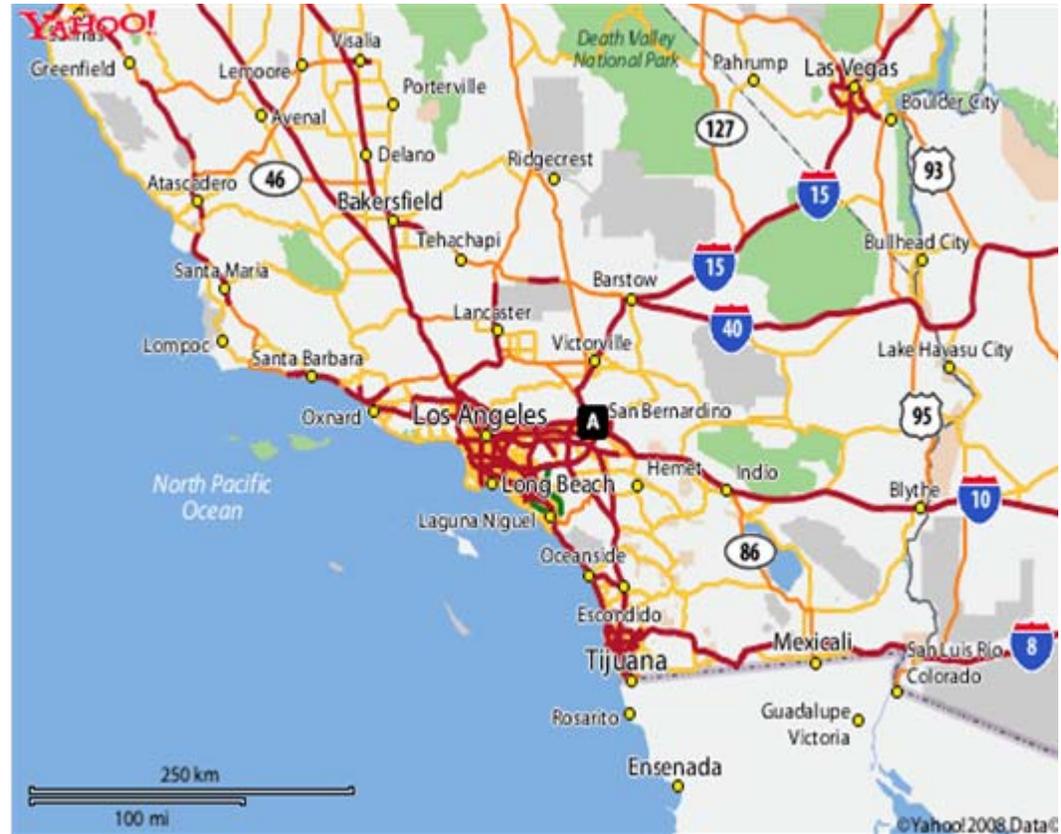
- Presented by CEO John Bryson in testimony before Congress
- Rising customer expectations and the needs of a technology-driven economy demand superior safety and reliability from electrical distribution circuits... at no increase in cost
- Advanced technology will make this possible
- The "Circuit of the Future" is a research initiative to explore technological advancements for future distribution circuits
- Covers transmission, distribution, and metering

- Digital systems controller to act as the circuit's "brain"
  - Identify, analyze, and isolate circuit problems
- Advanced fiber optic communication system
- Fault current limiters to rapidly sense and isolate problems
  - SCE first to use these devices
- Duct bank temperature monitoring
- Capable of using plug-and-play distributed generation
- AMI

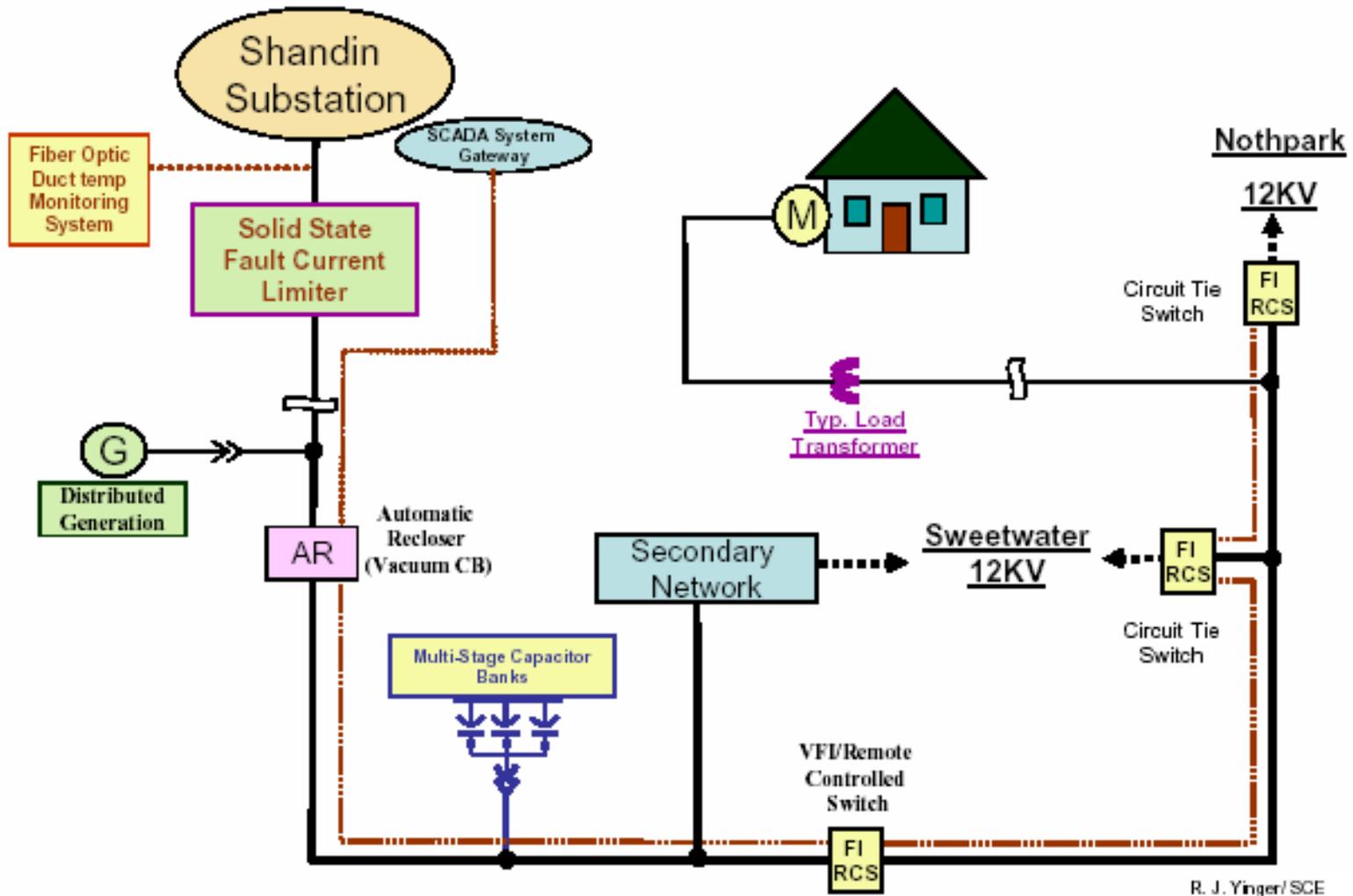
- Four regional distribution engineering teams
- SCE subject matter experts
  - T&D automation
  - Distributed generation
  - Communications
- Outside partners
  - DOE
  - Oak Ridge National Laboratory
  - EPRI
  - IntelliGrid
  - California Energy Commission
  - KEMA Consulting

# Test Site

- New 12 kV circuit
- Approximately 33,000 amps fault duty
- Expected to serve approximately 2,000 customers
- Includes both overhead and underground facilities



# The Circuit



- Modular poles w/ molded cross arms
- Automated devices
  - Vacuum fault interrupters (VFIs)
  - Automatic recloser (AR)
  - Remote controlled switches (RCS)
  - Duct bank temperature sensor
  - Distributed generation/VAR resource connect point
  - Multi-stage capacitor/transient-less switch
  - Fault current limiter
  - RFID tags with data
  - Active harmonic filter

# Modular Poles

- Replace some existing poles
- Benefits
  - Resistant to rot and insect intrusion
  - Engineered product so no variations in strength
  - Cross arms can be pre-assembled for fast installation and repair
  - Created in segments facilitating transportation and installation

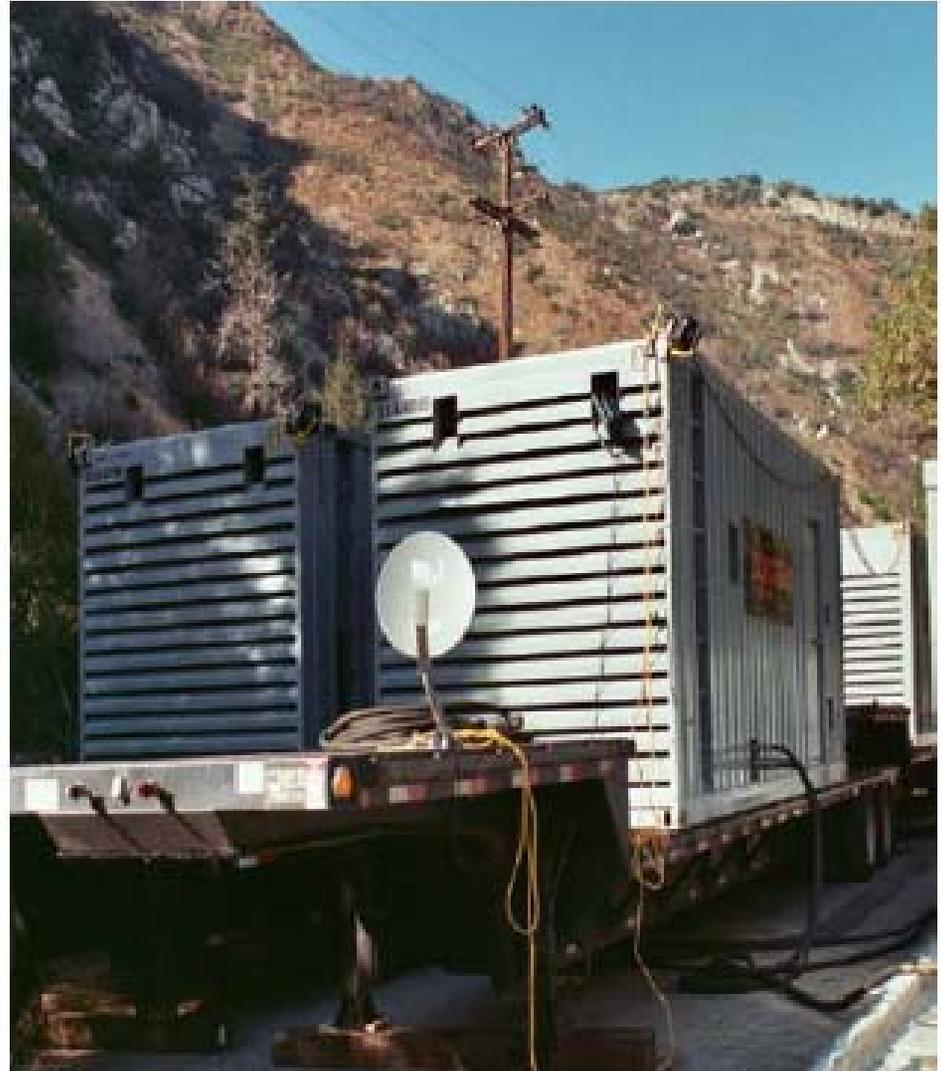


# Vacuum Fault Interrupter

- Installed in place of selected switches
- Able to interrupt fault current
- Benefits
  - Isolates fault to minimize area affected
  - Delivers line loading and fault indication data
  - Facilitates self-healing circuits
  - Plug-in bus design



- Interconnection point for distributed generation equipment
- Generate Watts and VARs
- Benefits
  - Supplement the feeder during high load conditions
  - Use generation for variable VAR support



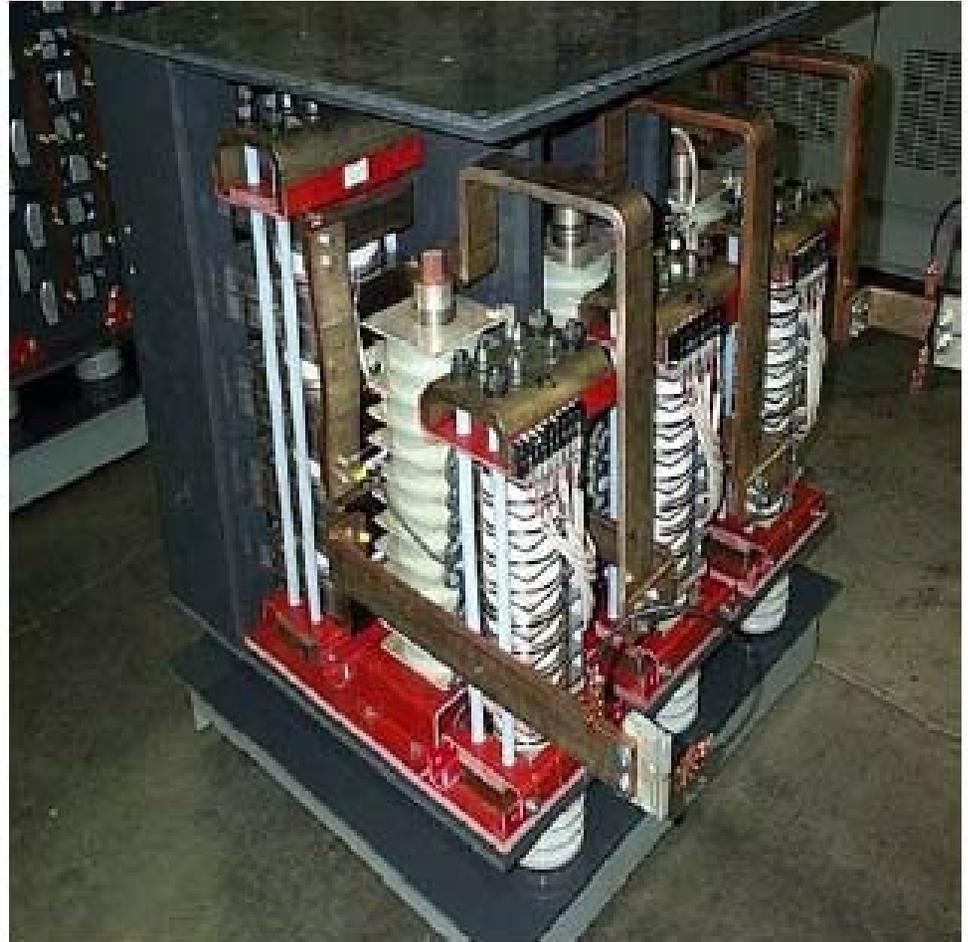
# Capacitor Switch

- Install one multi-step bank to replace several normally installed on the circuit
- Either pole or pad mounted
- Benefits
  - Reduce switching transients
  - Less capacitor banks required on circuit



# Fault Current Limiter

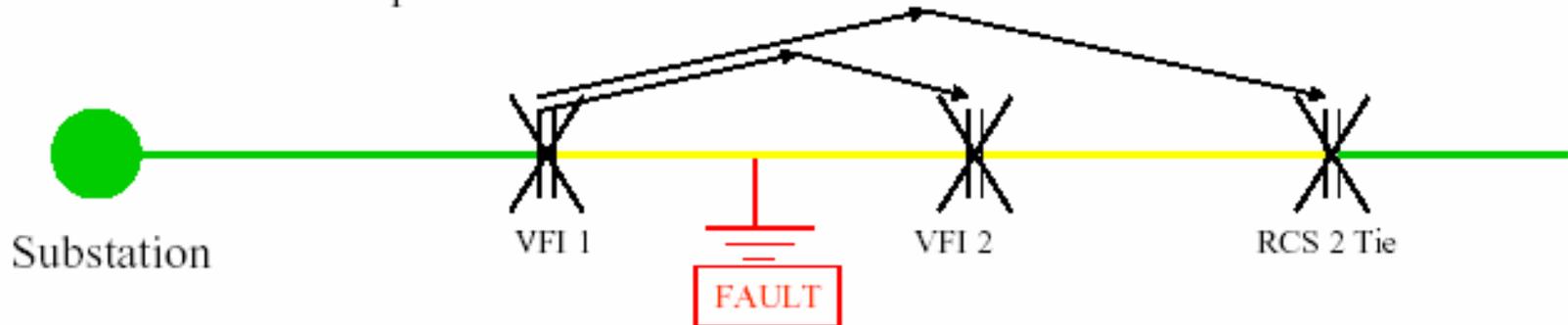
- Install at head of feeder to limit fault current
- Various technologies being explored
- Benefits
  - Allow devices further along on the circuit to have a lower fault current rating
  - Lower stress/costs for equipment downstream
  - Greater safety due to less violent failures



- Utilinet 900 MHz radio for critical switching operations
- Fiber to critical nodes to allow high-speed fault isolation and monitoring
- May test BPL for transport of utility data
- Test bed for AMI and demand response devices

# Fault Example

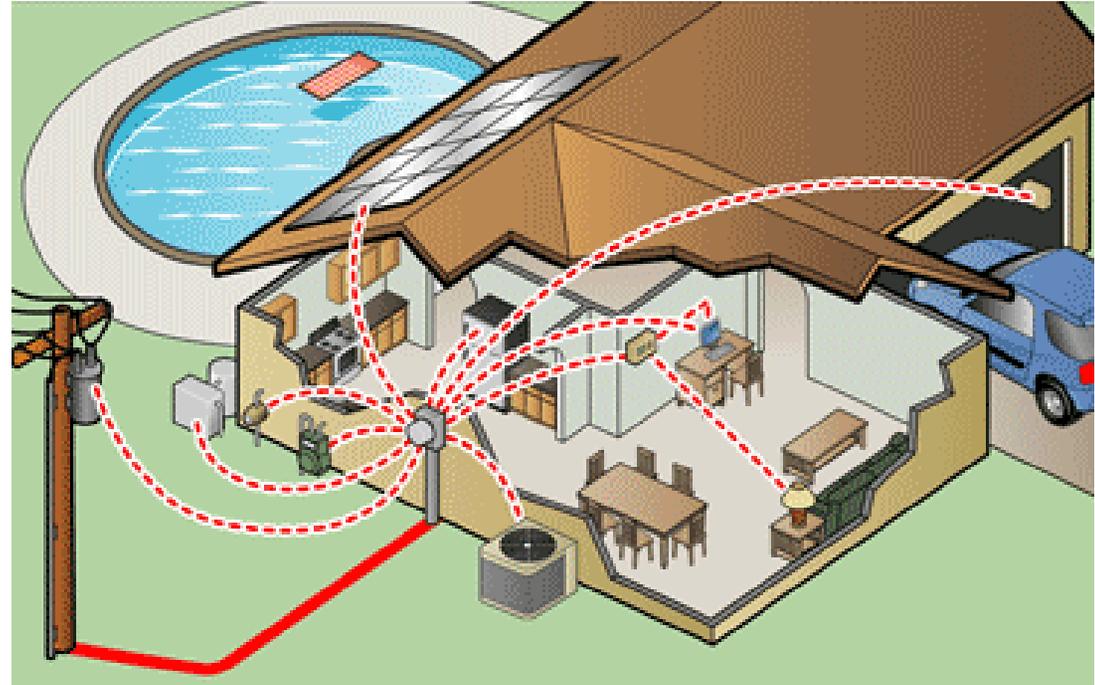
SCENARIO:  
Fault After Interrupter



Step	Time (sec)	OPERATION
1	0000	VFI 1 Trips Opens (Fault)
2	0015	VFI 1 Requests VFI 2 to Open
3	0030	VFI 2 Opens
4	0045	VFI 1 Retests and Trips Open (Fault)
4	0060	VFI 1 Requests Load Transfer to RCS2 Tie
4	0070	RCS 2 Tie Evaluates Load Request and Closes If Acceptable Crew Begins patrol.

- VFIs will have directional sensing and will go solid if fed from reverse direction
- History data server will store load data
- After fault section is isolated, then:
  - Computer system will analyze peak loading for previous week
  - Suggest to operator the appropriate tie switch(es) to close
  - Operator restores the unfaulted line section(s)
  - Move to automated restoration (self-healing) later

- Wireless communications
- Meter to premise data
  - Usage data
  - Price data
  - Control signals
  - Alerts
- Other possible functions
  - Home automation
  - Appliance control
  - Security monitoring
  - Etc.



Source: SCE

- Operational
- All five technologies installed and functional
- Serving 1,400 customers
- Field testing AMI
- Runs through end of 2008