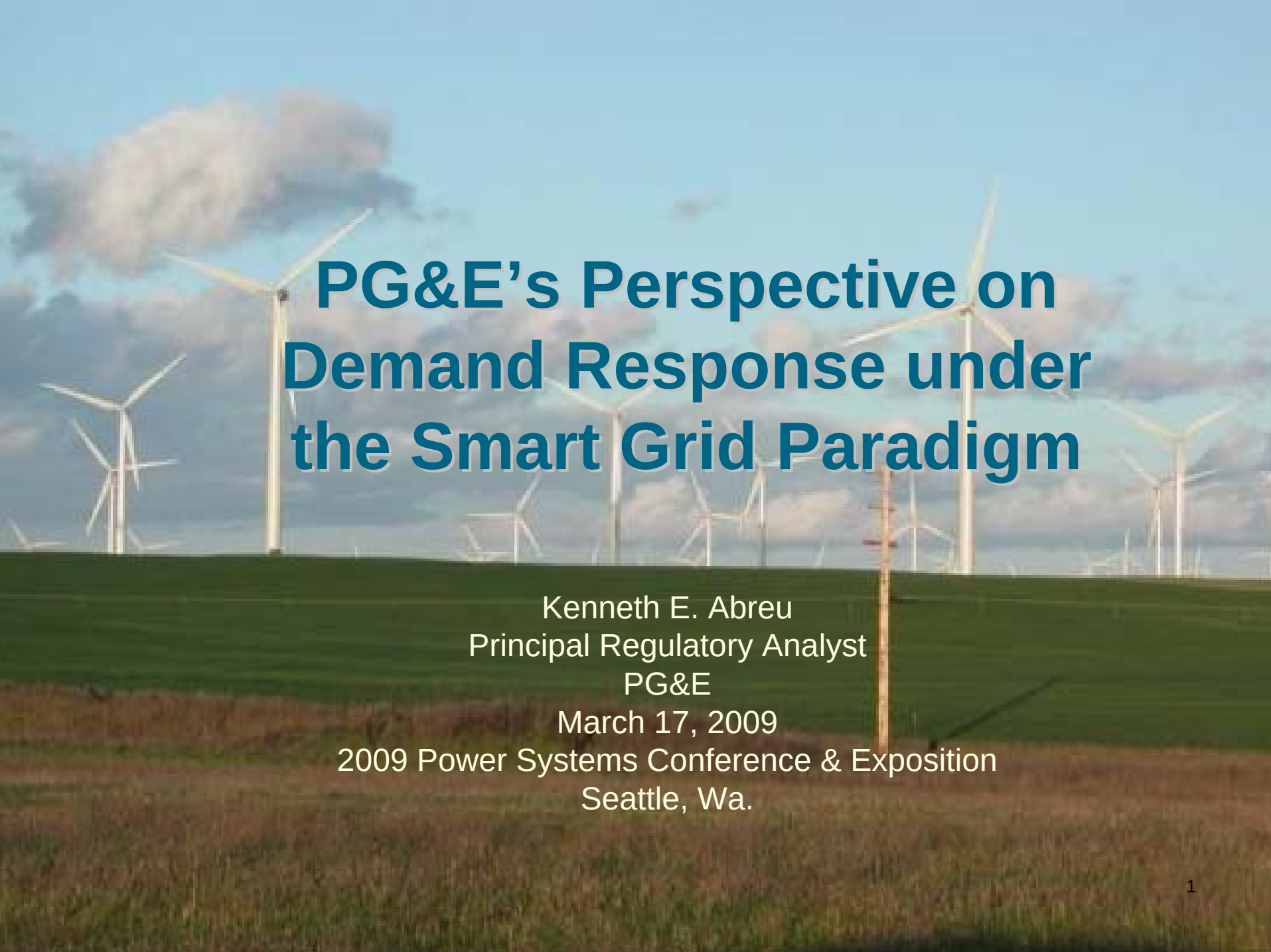

PG&E's Perspective on Demand Response under the Smart Grid Paradigm

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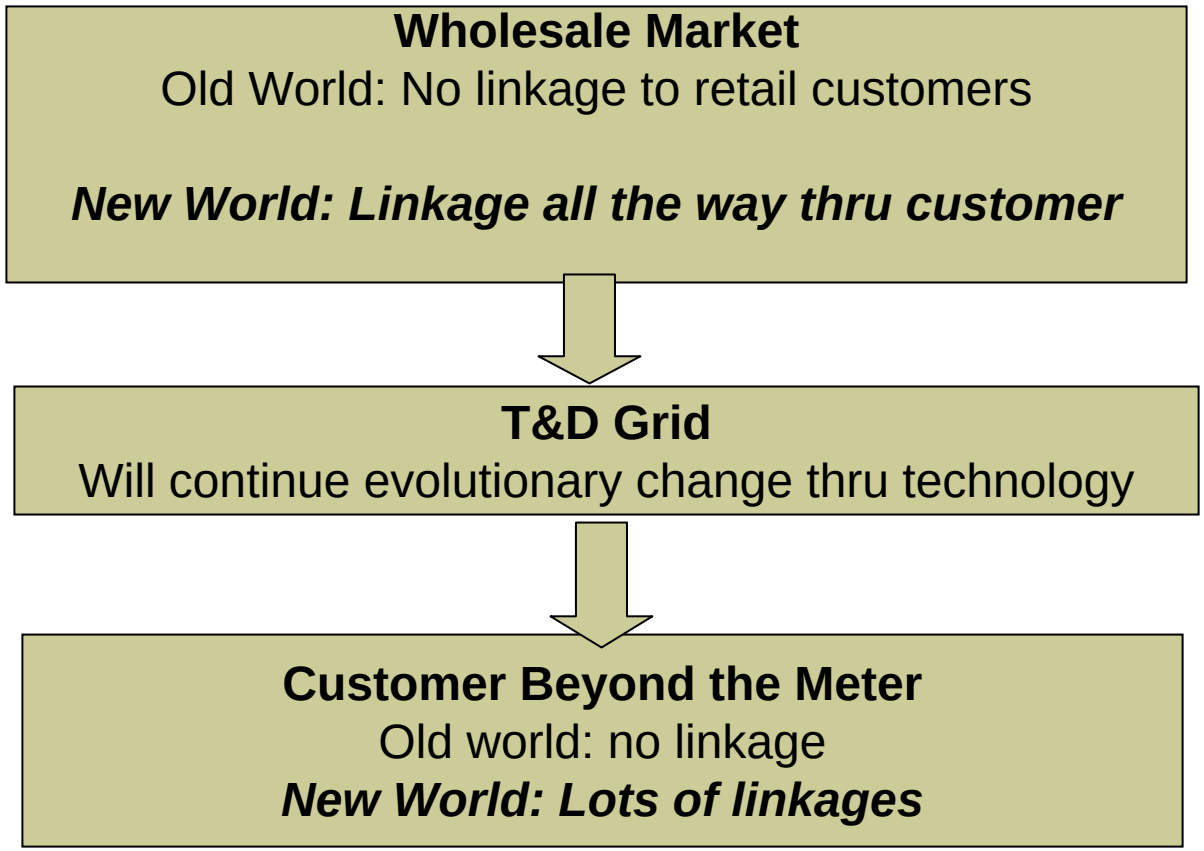
PG&E
March 17, 2009
2009 Power Systems Conference & Exposition
Seattle, Wa.

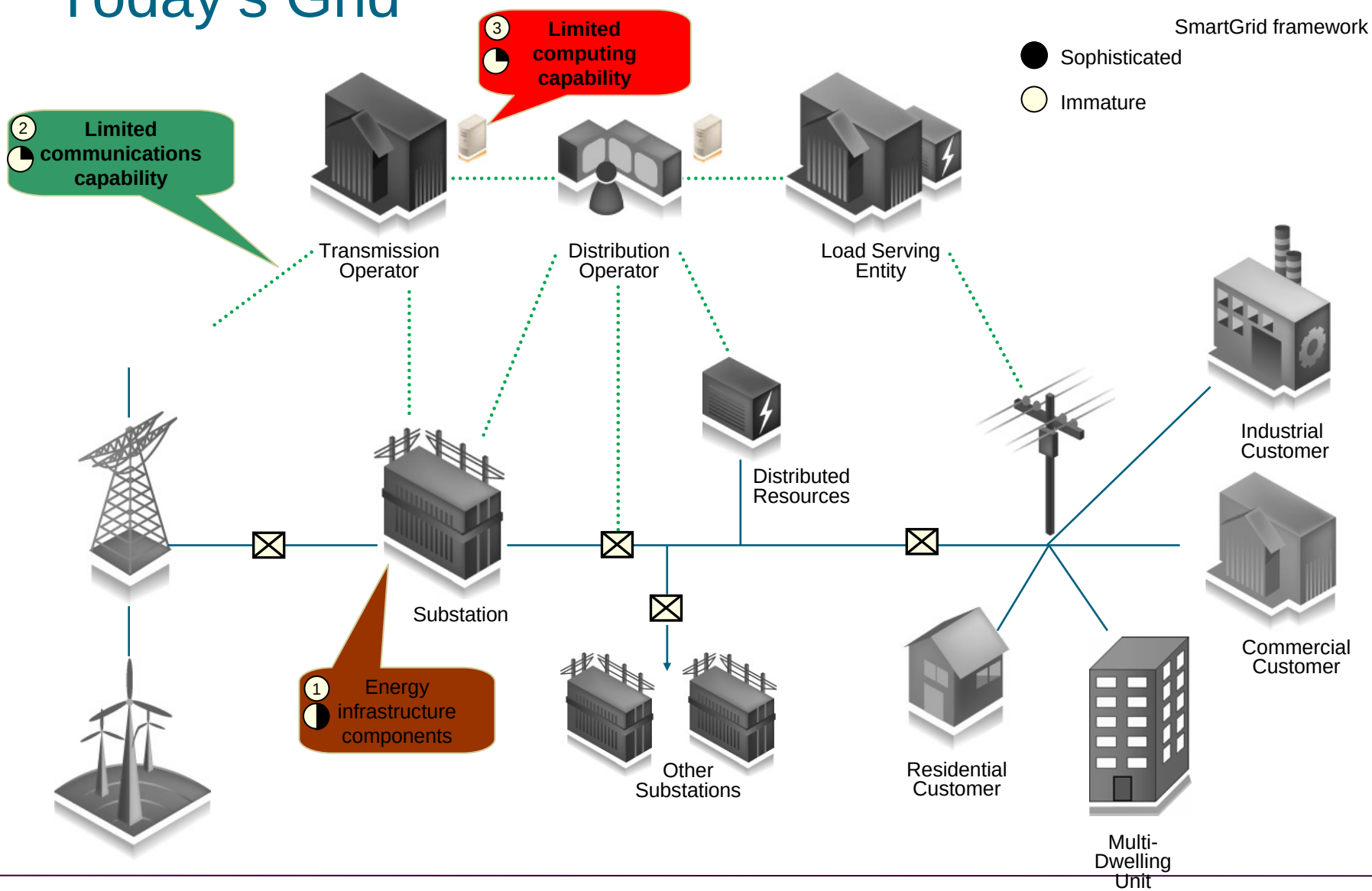
Outline of Presentation

- PG&E's Smart Energy Web Vision
- SmartMeter Deployment
- PG&E's 2009-11 Demand Response Plan
- PG&E's Demand Response Pilots
- Dynamic Rates
- Demand Response, SmartGrid and Renewables
- Summary

What is Changing in Smart Grid to Advance DR?



Today's Grid

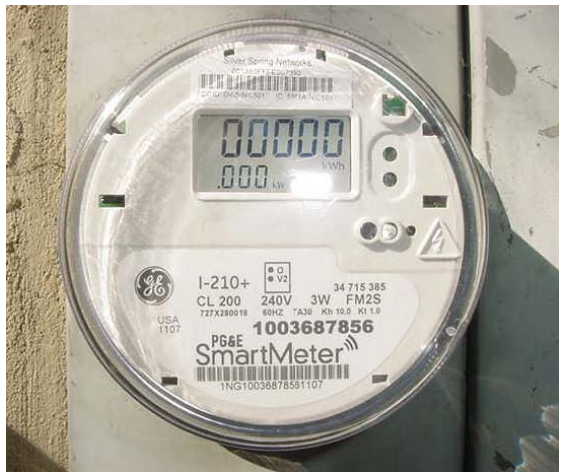

SmartGrid framework
Sophisticated
Immature
3 Limited computing capability
2 Limited communications capability
Transmission Operator
Distribution Operator
Load Serving Entity
Distributed Resources
Industrial Customer
Substation
Commercial Customer
1 Energy infrastructure components
Other Substations
Residential Customer
Multi-Dwelling Unit
Communications
Switching Device

Smart Grid Components: Pervasive Sensing Devices

Grid

Distribution Load Sensor

Premise



SmartMeter™ Electric Meter

In the Home

Appliance-level Electric Usage Monitor

Smart Grid Components:
An Advanced Communications Network

Network Access Point

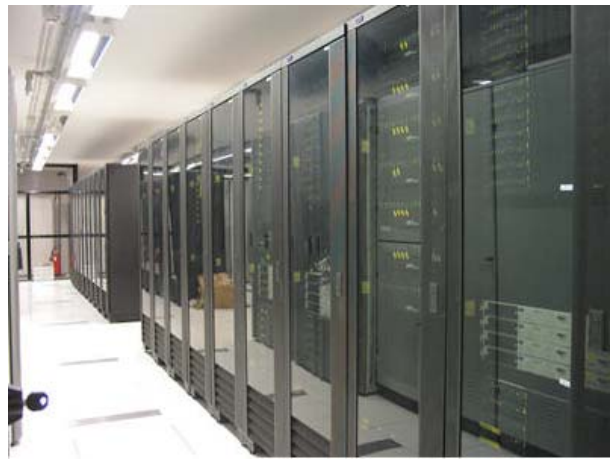
Public Wireless Network

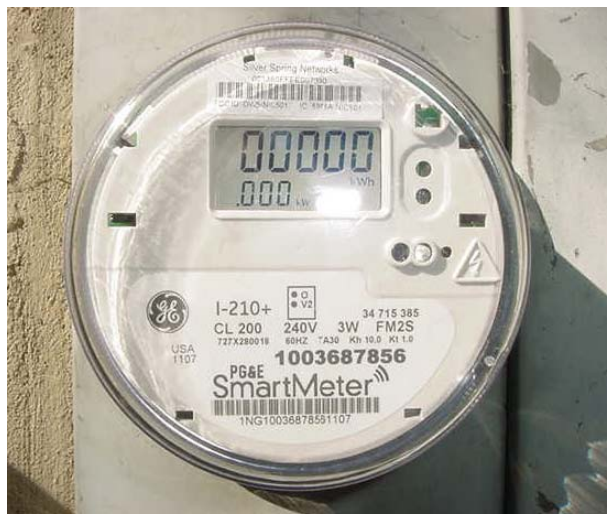
In-Home Network

SmartMeter™ Electric Meter

Smart Grid Components: Robust Computing Capability

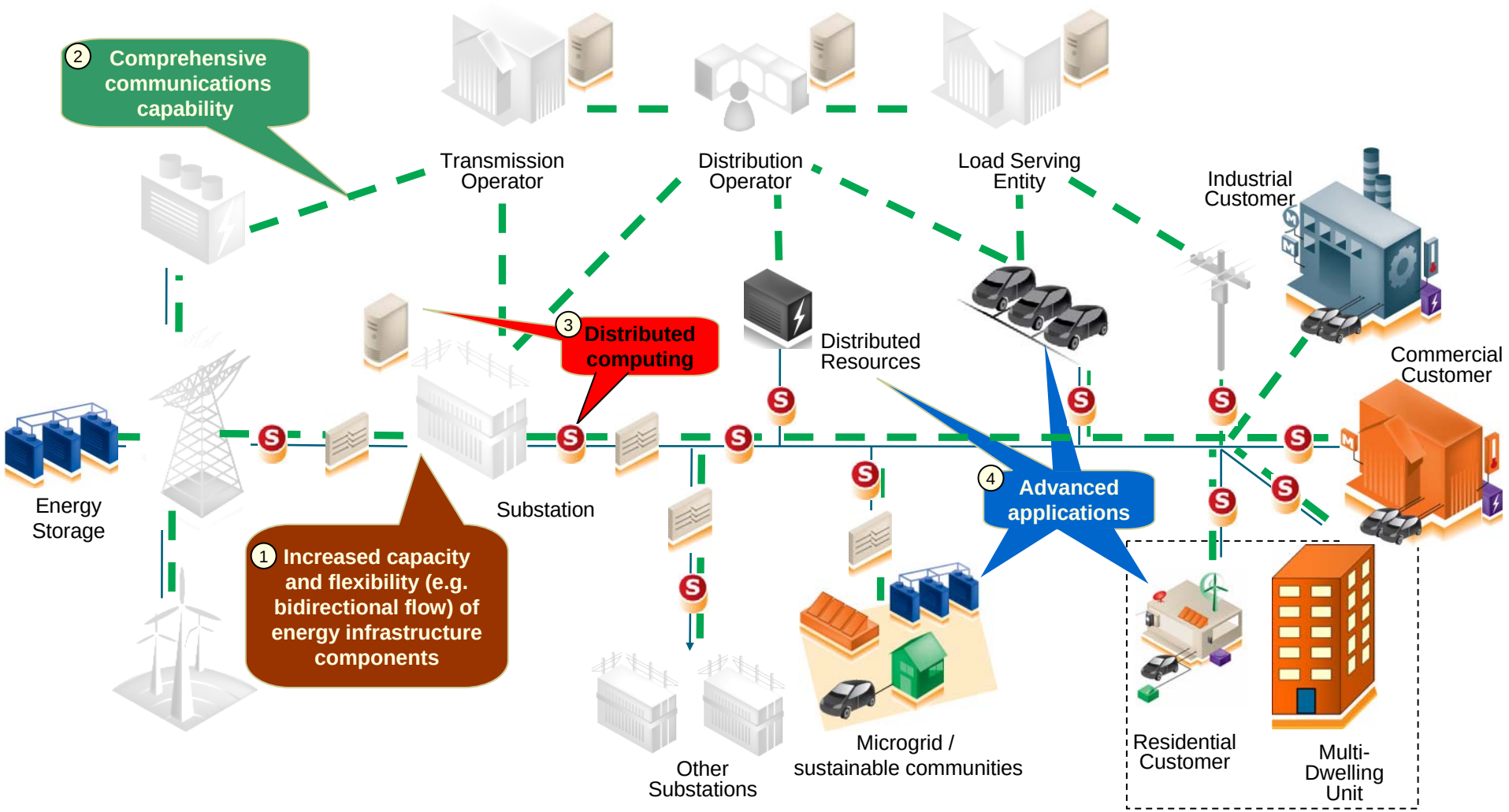
- Both centralized and distributed
- 110,000 gigahertz of processing capability
- 65,000 gigabytes of stored data per year





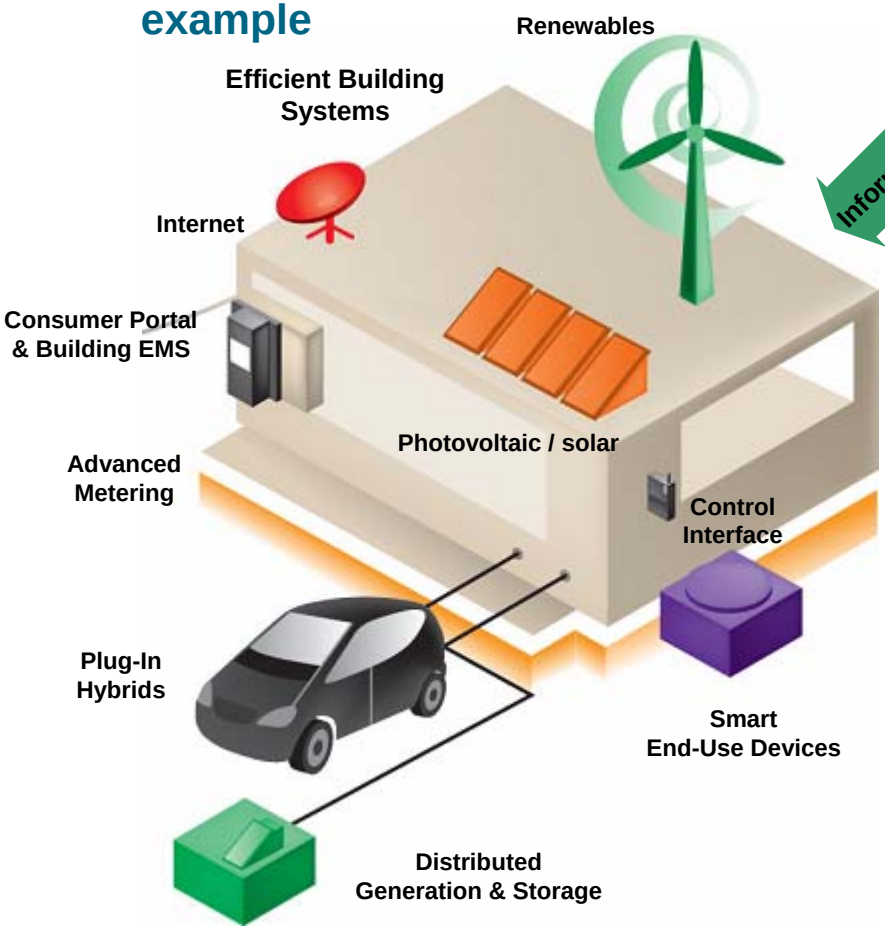
Future Smart Grid

SmartGrid framework



Smart Grid Customer Opportunities

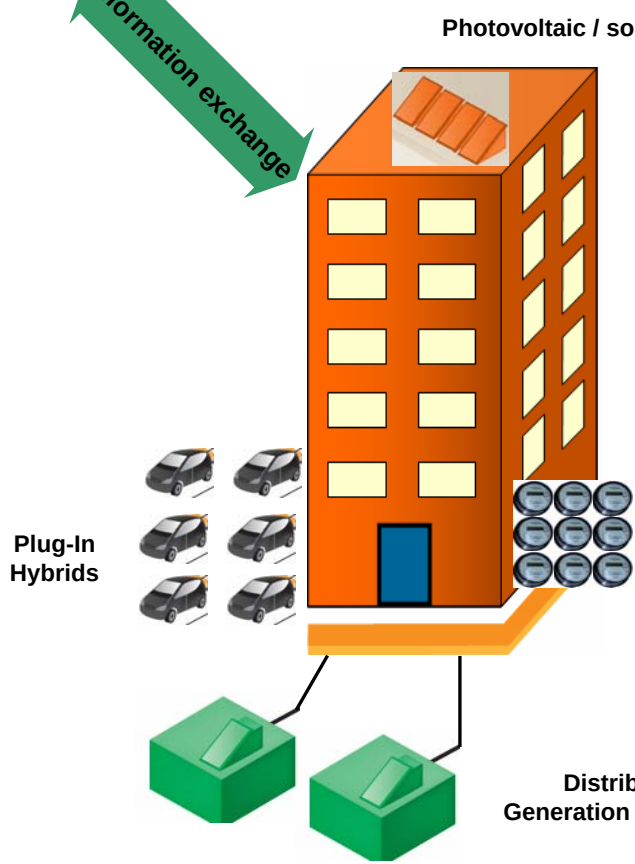
Single home example



Information exchange

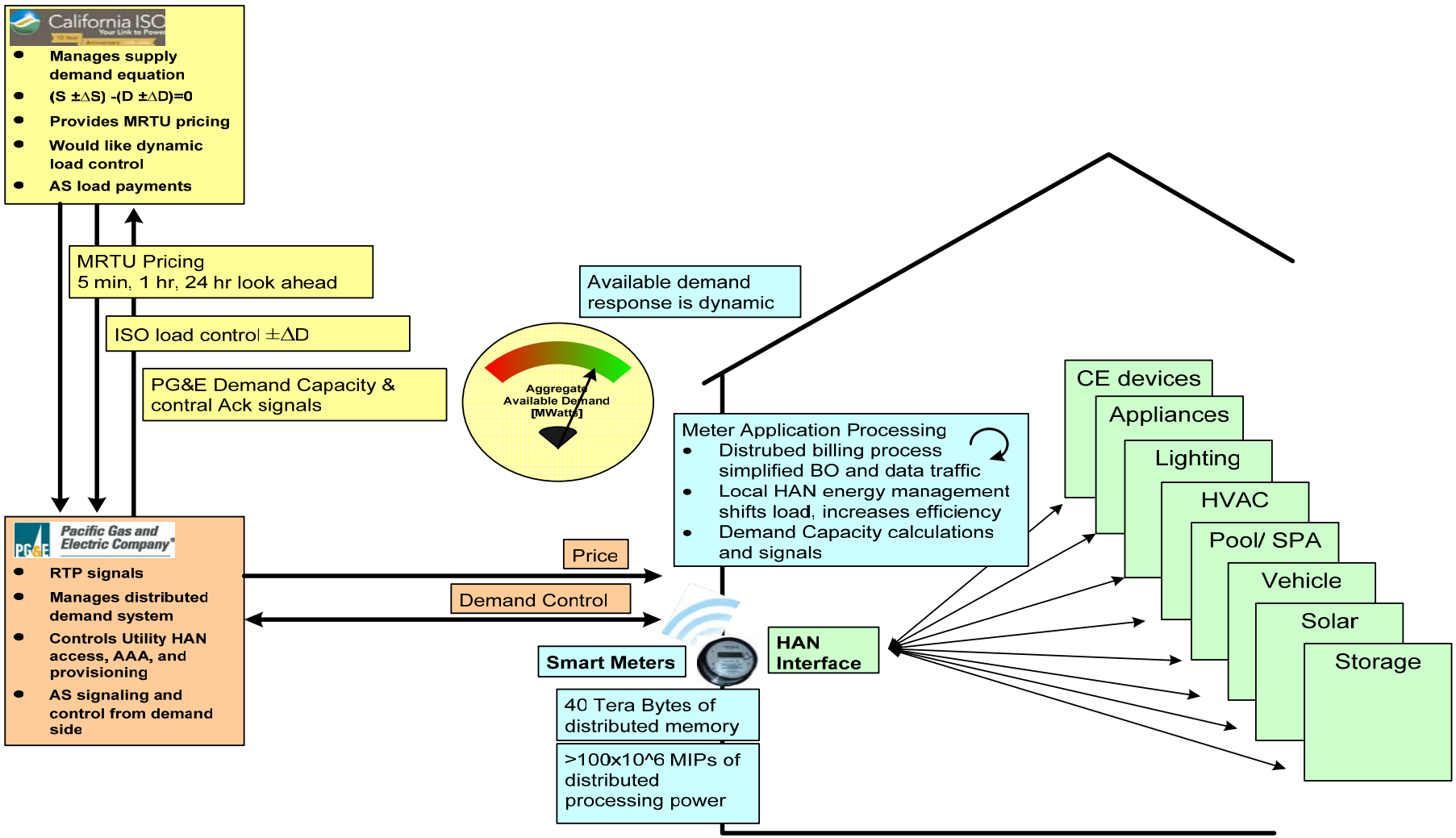
Information exchange

Multi-Dwelling Unit example



A little more detail

All systems are interdependent. New systems must consider how they need to communicate across systems in a distributed way



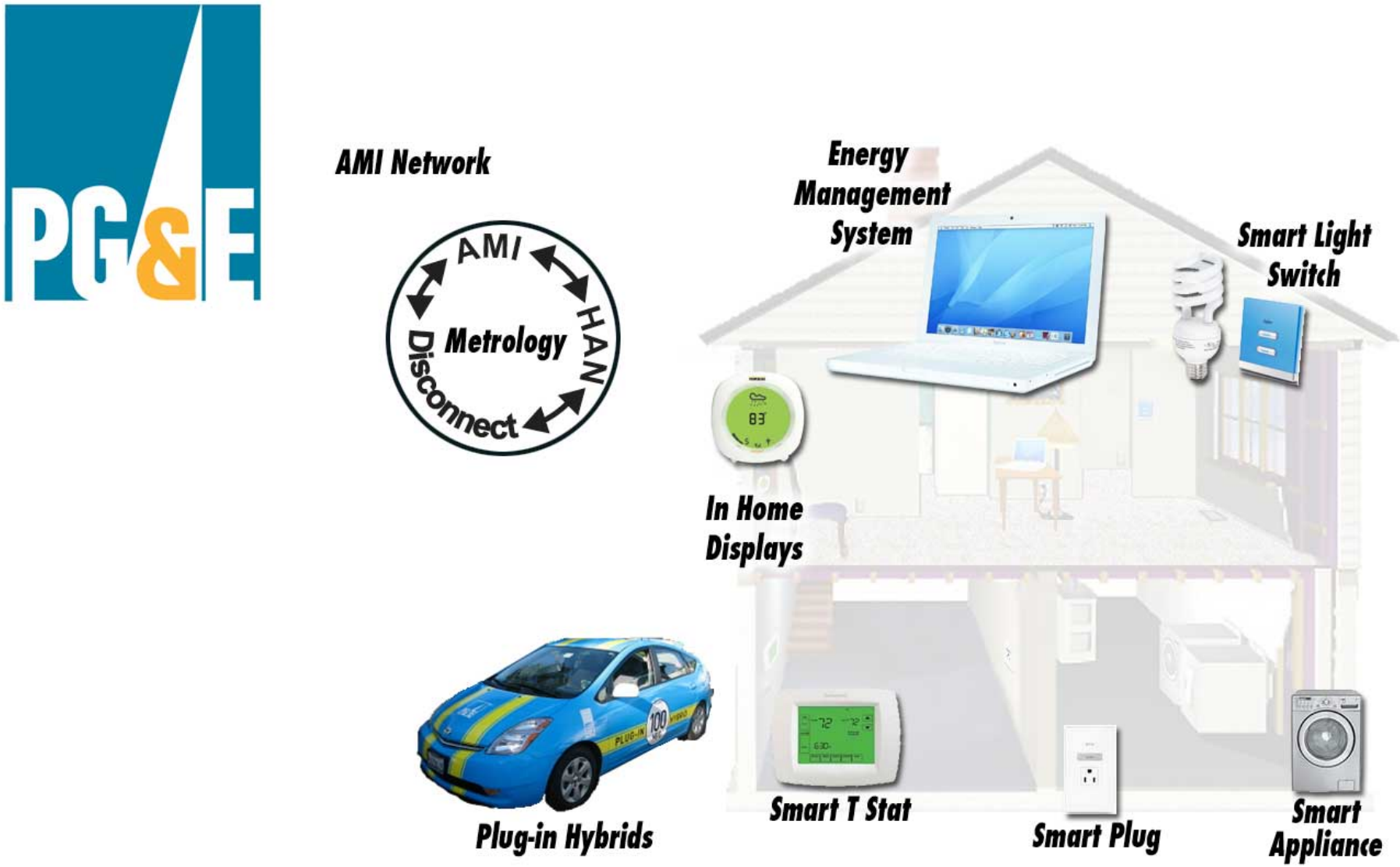
Smart Grid Vision

- **We do not need to define the end state**
- **Define a minimum base set of architectural boundaries**
- **Legacy systems migrate into these overtime as much as possible**
- **Overtime we evolve into PG&Es SmartGrid**
- **Open Standards are key to Smart Grid:**
  - Without open standards a SmartGrid will not be achieved
  - Without industry compliance a SmartGrid will not be achieved

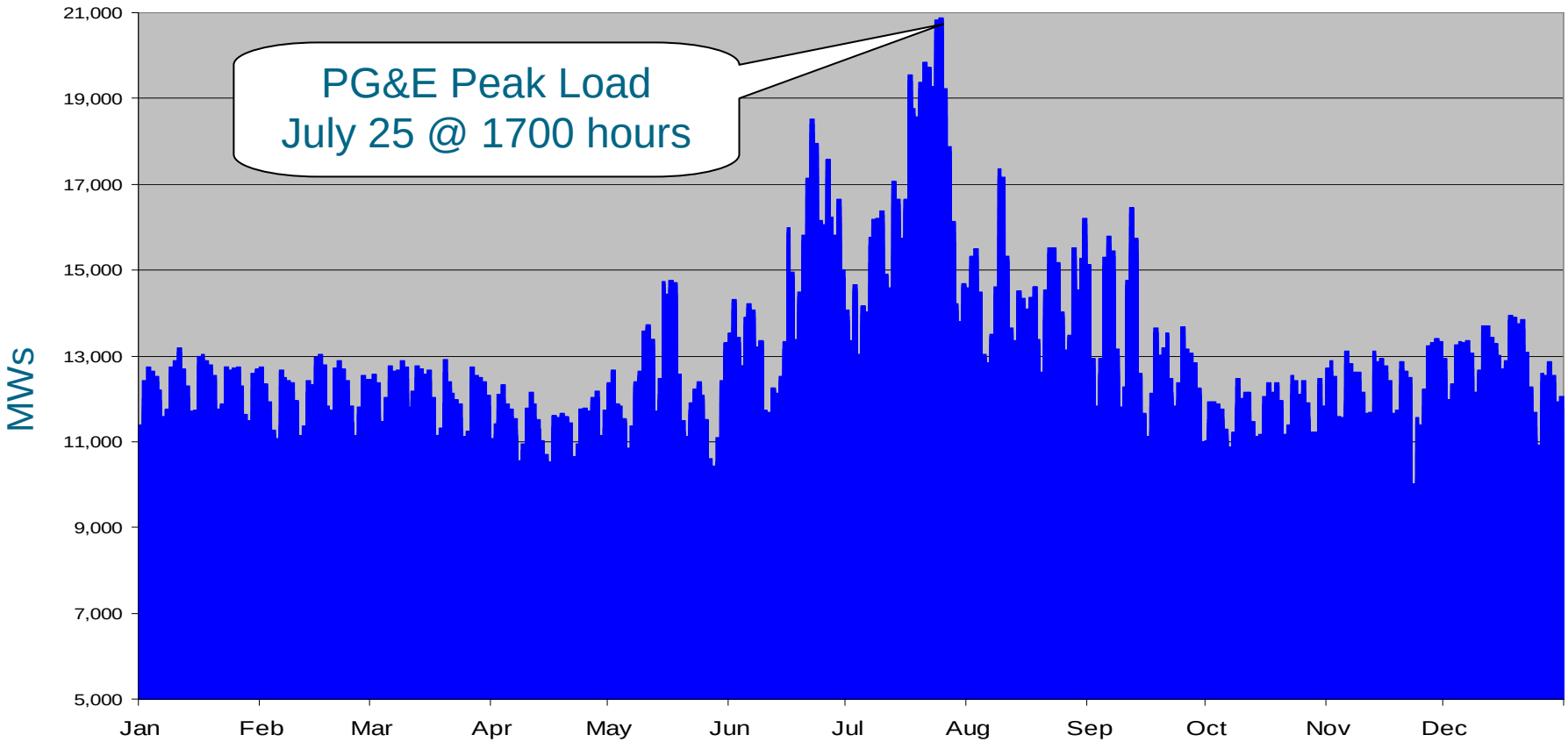
The PG&E SmartMeter Program

- Automated meter reading
- 10 Million meter upgrades
- A network to collect meter reads remotely
- Frequent meter reads - daily for gas, hourly or 15 minute interval for electric
- Enables demand response rates and customer home/premise automation
- Enhanced capabilities over time

SmartMeter Upgrade Technology

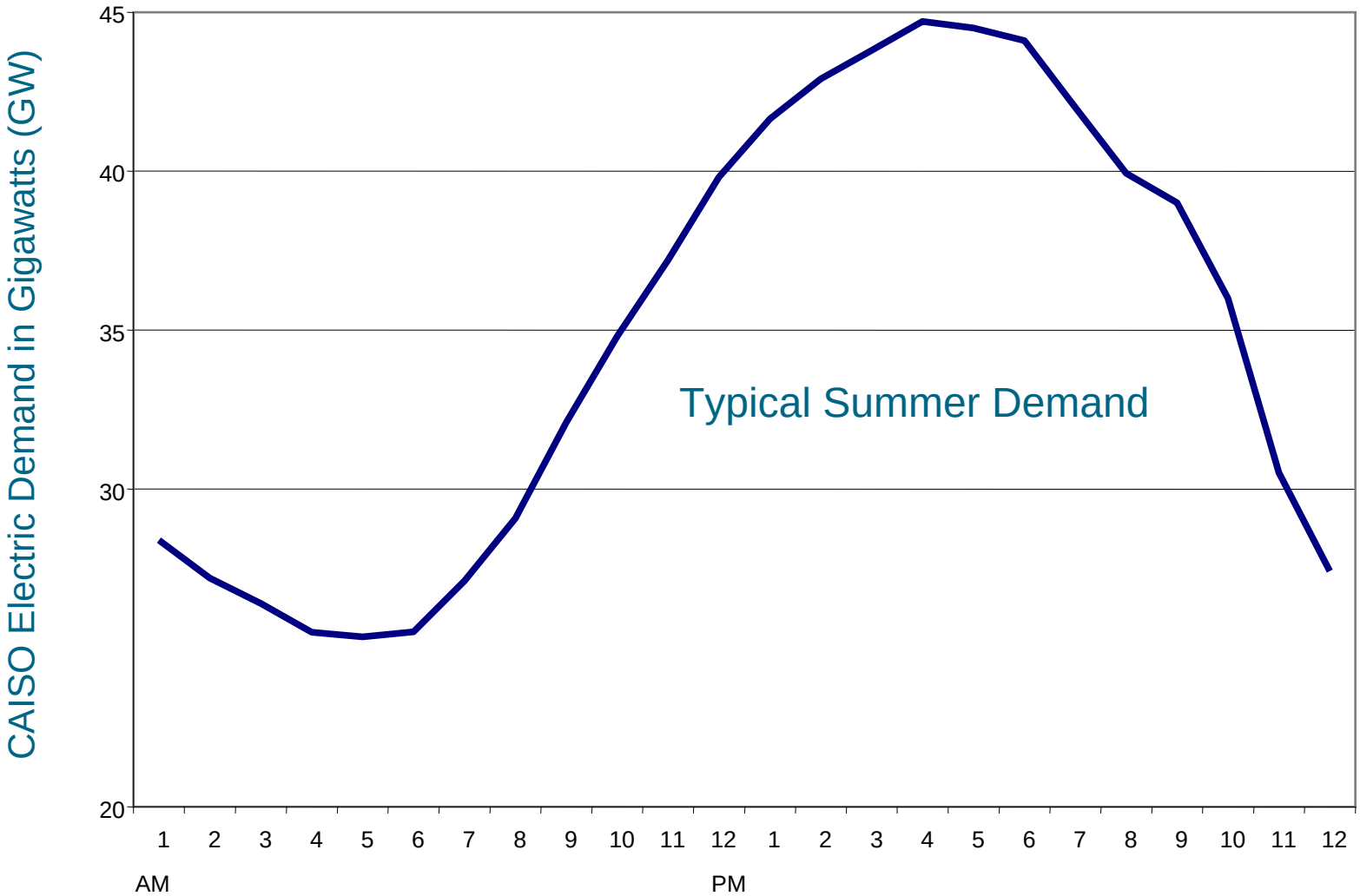


Electric Demand Is Seasonally Variable



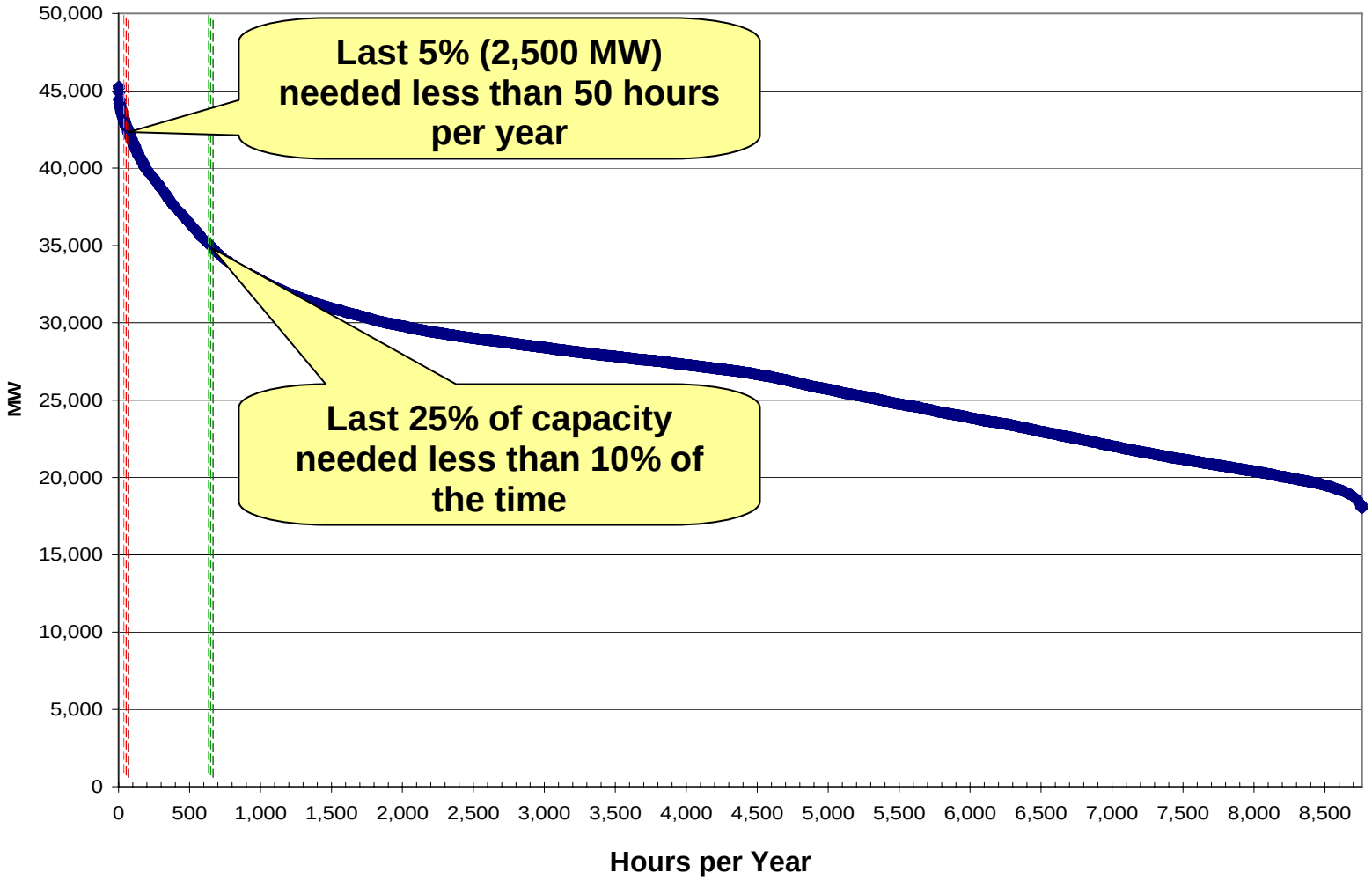
2006 Annual Usage

Electric Demand Varies Significantly Over The Course Of Each Day



Utilities *Must* Maintain Enough Generation To Supply Peak Demand

Peak Generation Capacity Sits Idle Much Of The Time



Source: California Independent System Operator Corporation

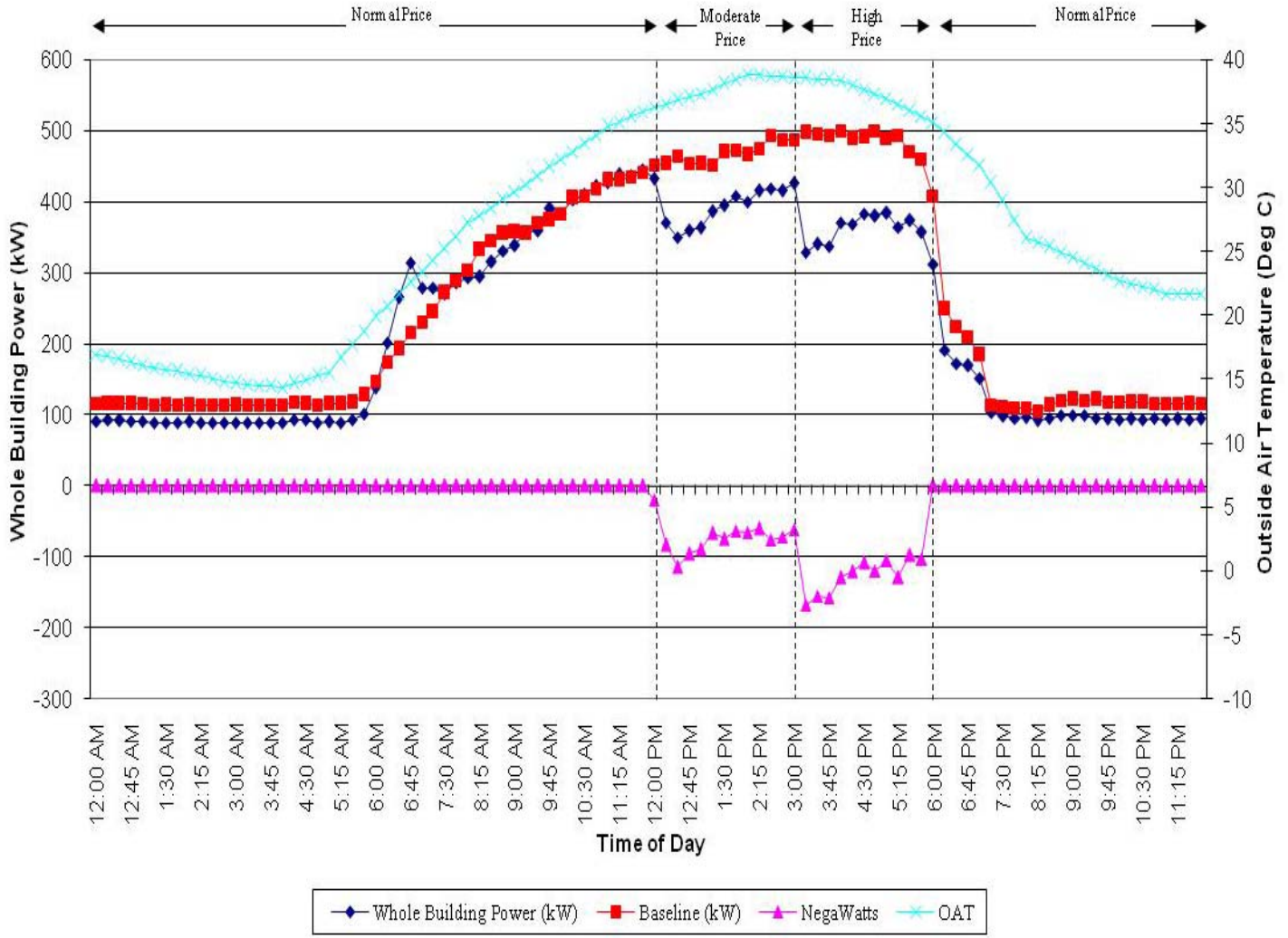
Smart Grid Enables Automated Demand Management

Home Area Network communication

SmartMeter communication

Automated Demand Management Generates Negawatts

Martinez, CA office building electricity use with and without automated demand response, June 21, 2006



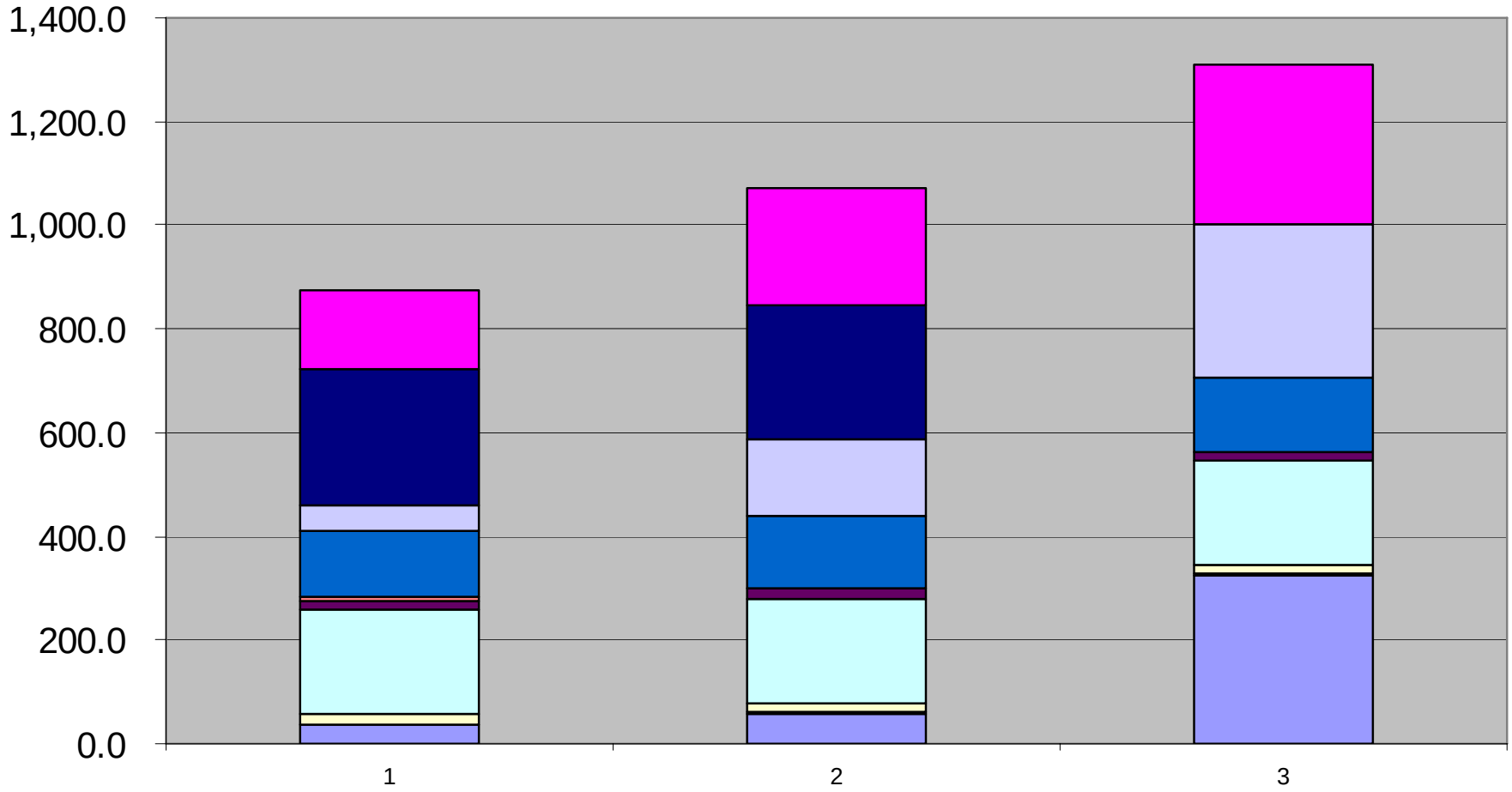
PG&E's 2009-11 Demand Response Plan

- Several price responsive programs are included in PG&E's program.
- DR Service Provider (Aggregator) programs are a major and growing part of the DR portfolio.
- Emergency programs will continue to be an important part of PG&E DR programs as well.
- Auto DR is a program that provides for an automated system to signal customers Energy Management Systems to initiate a DR event. This program has been successful for PG&E in the past and it is planned for growth. Automation is a key to significant, reliable, cost–effective DR.

2009-2011 Major DR Trends

- Integration of DR with MRTU
- Integration of DR with Energy Efficiency and Distributed Generation
- Integration of DR with Smart Meter, HAN and future Dynamic Pricing Tariffs

2009-11 growth (per filing)



DR pilot projects

- PG&E is planning two Ancillary Services (AS) pilot projects.
- Also two pilots to help with integrating renewables:
- Also a pilot on aggregating small commercial/industrial customers'

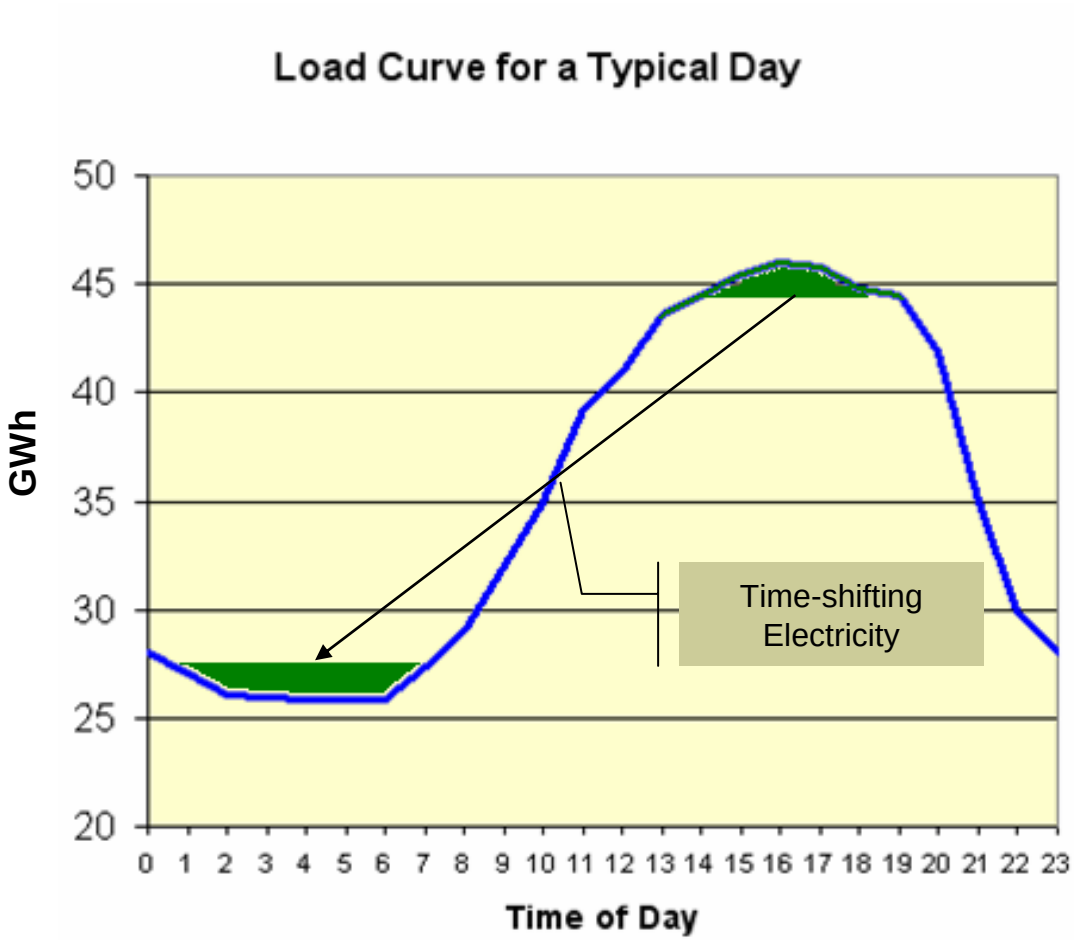
Ancillary Services (AS) pilot projects

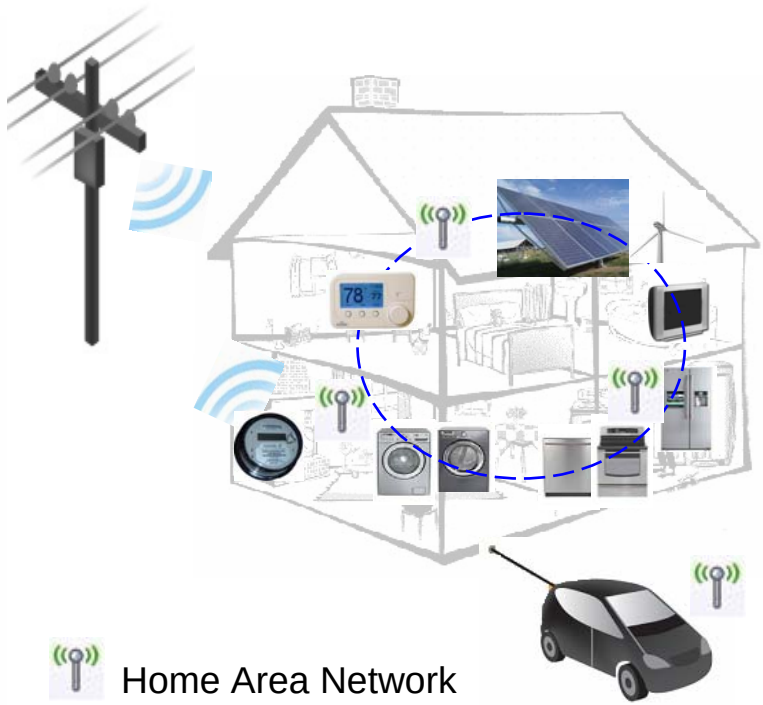
- One for Commercial & Industrial (C&I) customers that is targeted for summer of 2009
  - 3 to 4 sites
  - Telemetry at each site
  - Auto DR technology
  - Bid AS to CAISO market
- Residential air conditioning customers in our DR program provide a potential AS product.
  - 2 climate regions
  - 3 feeders each
  - Each feeder has different technology
  - Visible to CAISO at feeder level

Pilots to help with integrating renewables

- Provide regulation/load following using distributed storage.
  - Refrigerated Warehouse (thermal)
  - Batteries (electric)
- Plug-In Hybrid Electric Vehicle (PHEV) and Electric Vehicle Smart Charging pilot projects will be an additional pilot.

Smart Grid Enables Electric Vehicle Smart Charging





Home Area Network

AMI/SmartGrid

Electric Vehicles (EV) – Potential major Advancement

- Old Rules
  - “Electricity can’t be stored economically – so generation must meet load in real time”
- EVs could change this rule and thus the nature of the grid
  - The storage is now “paid for” by someone else.
  - Possible charging and discharging to signals

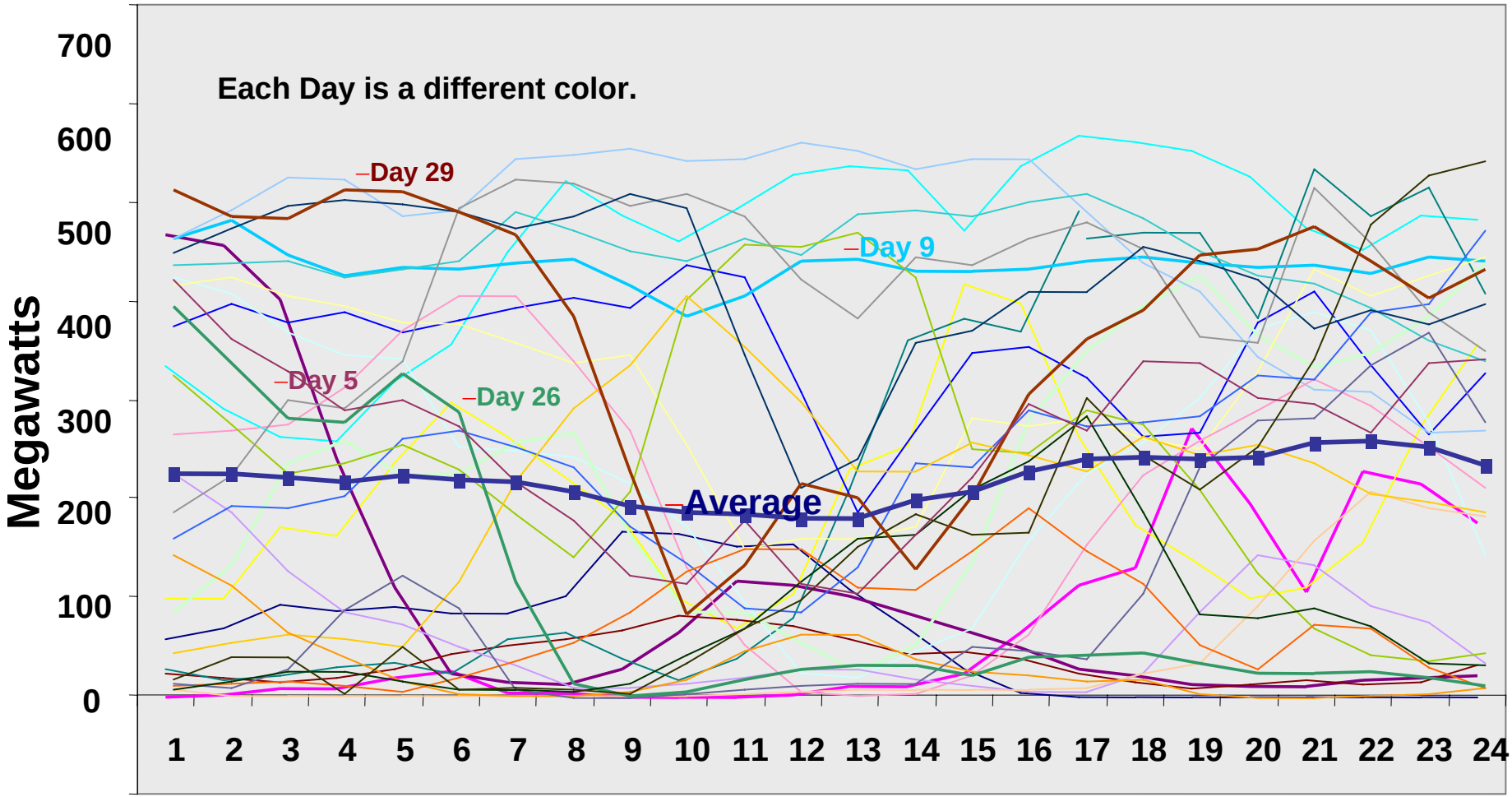
Dynamic Rates

- A recent CPUC decision on Dynamic Rates will have ***all*** non-residential customers eventually defaulted into a DR program by 2011-12.
- The decision includes the implementation of Real Time Pricing for major classes of customers.
  - Initially the CAISO day ahead prices will be utilized to determine these rates.

Smart Grid Necessary for Integrating Renewable Energy into the Grid

33% Renewable Portfolio Standard by 2020!

Wind Is Highly Variable And Difficult To Predict

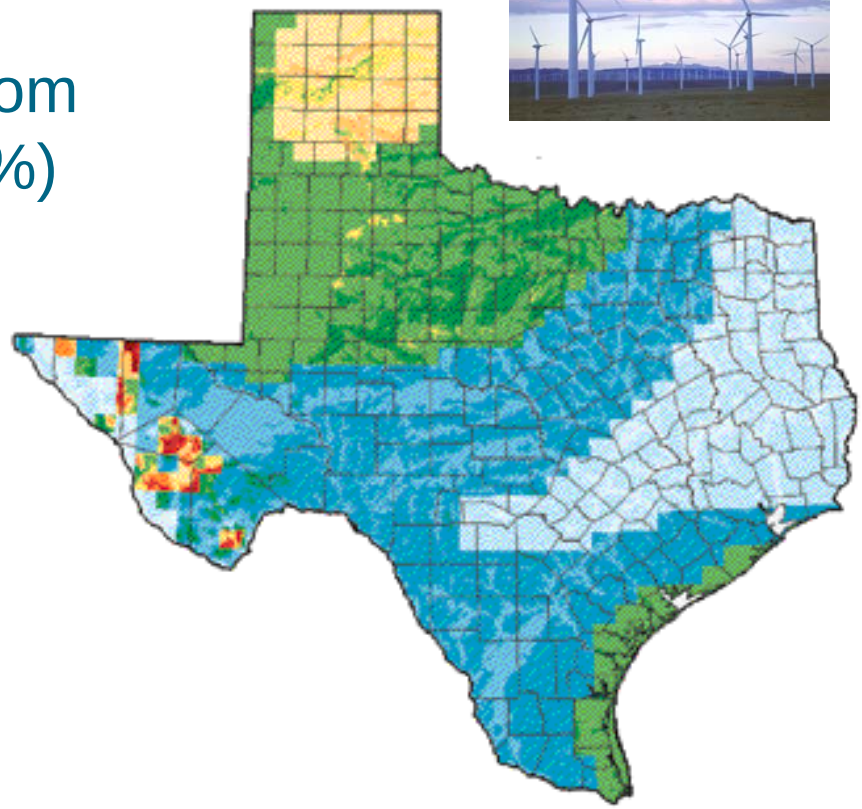


Source: Cal ISO

This Variability Can Seriously Threaten Reliability

Texas, February 2008

- Wind generation dropped from 1,700 MW to 300 MW (~80%)
- Required demand curtailment of 1,100 MW in 10 minutes



Summary

- SmartGrid and Smart Meters will open up more opportunities for Demand Response
- Transparent wholesale markets will further expand DR opportunities
- DR as AS has potential
- DR may allow more renewables into grid
- The ability for communications and control linkages between customers and both the T &D grid and wholesale market creates major new opportunities for DR.