An Overview of
California Smart Meter Policy & Deployment

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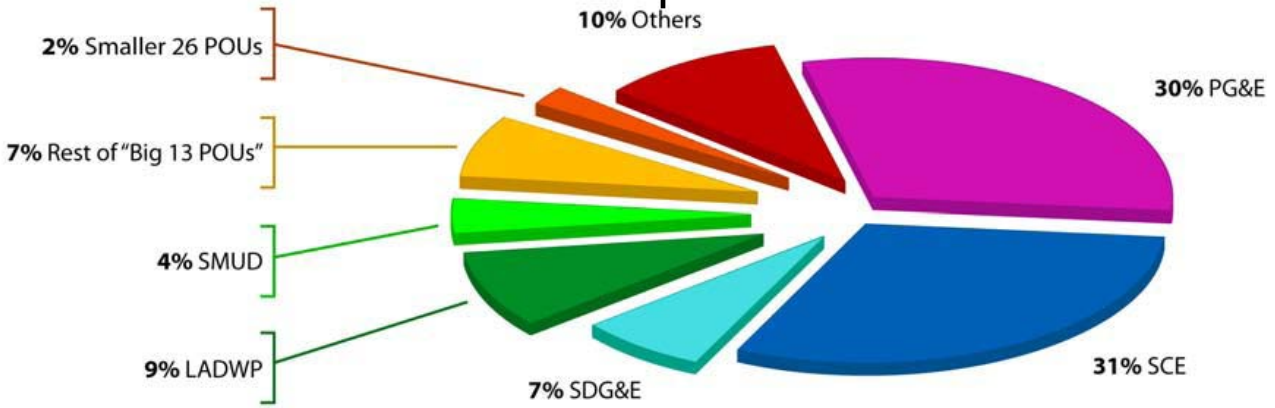
Smart Meters (aka Advance Metering Infrastructure - AMI)

- **California Smart Metering Overview**
- **Cost / Benefits**
- **Goals / Objectives**
- **Challenges in Affecting Customer Behavior**

Smart Meter Deployments Now in Progress

- **In 2003, CPUC ordered that all electric customers should have advanced (smart) meters**
  - Applicable to three major Investor-Owned Utilities (IOUs)
  - Represent about ~68% of consumption

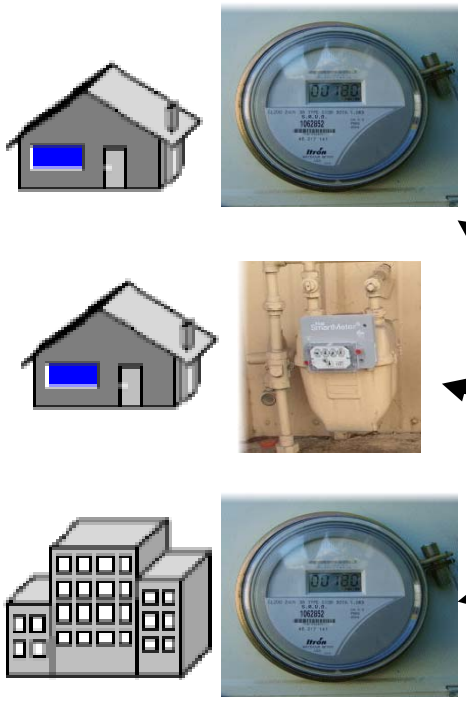


Source: California Energy Commision

Utility Shares of California's Electricity Consumption (2006)

- **Today, residential smart meter deployments in progress by all three IOUs**
  - Already in place for large commercial & industrial customers

Smart Meter System / Network Overview



Smart Meters

Data Collection Unit (DCU)

Network Mgt System

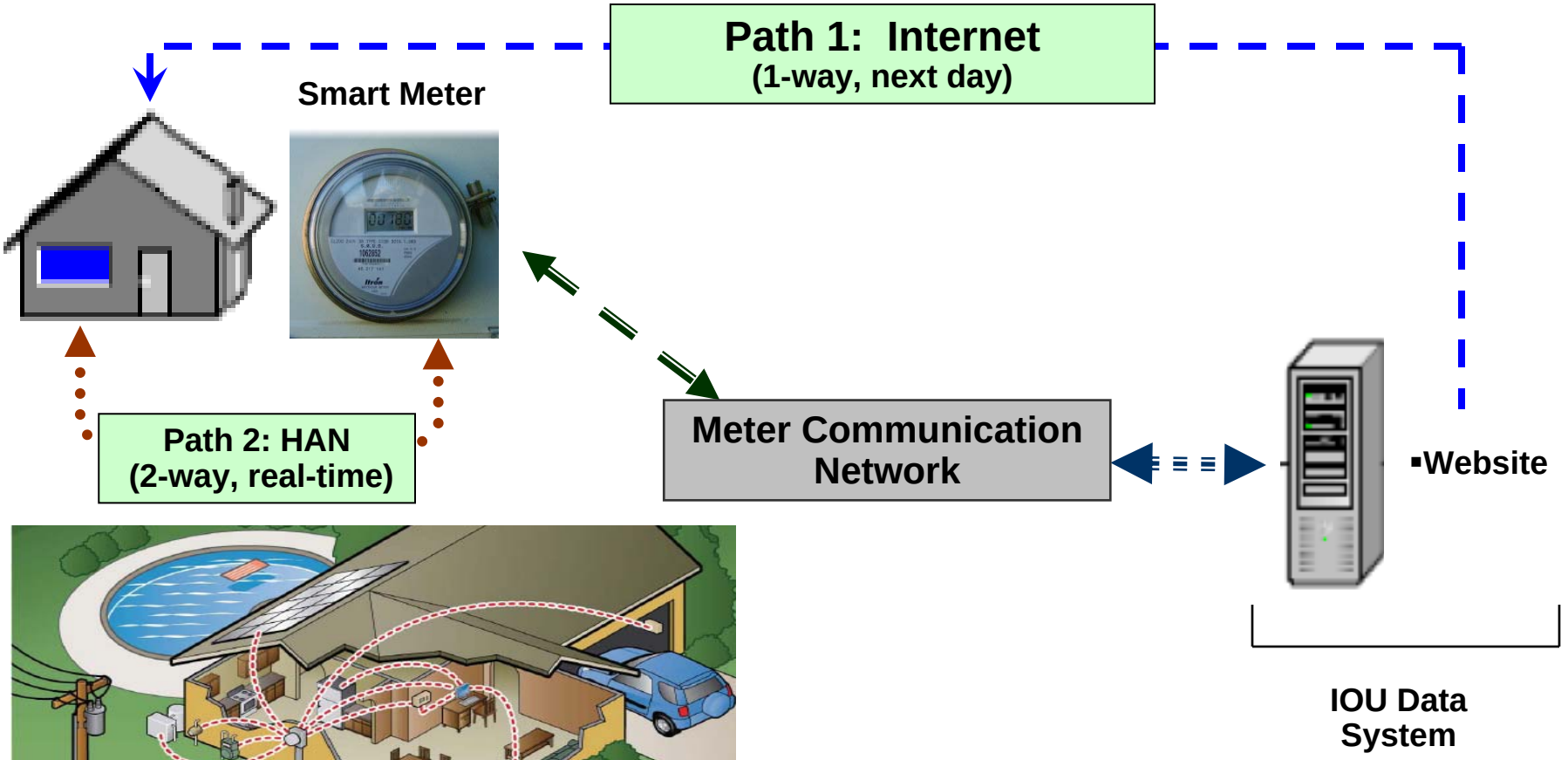
Data Management System

- •Website
- •Billing
- •Outage Mgmt.
- •Load Control

“LAN” (Proprietary 900 MHz Fixed Wireless)

“WAN” / Backend (Standard)

Two Methods to Provide Usage Feedback



Home Area Network (HAN) = Zigbee (a communication protocol)

Smart Meter: Minimum Functionality Required

Increase system efficiency

- Enhance operating efficiencies and savings
  - Auto meter reading, outage management, improved forecasting, theft reduction
- Support billing, customer support, outage management
- Interface with Direct Load Control communication technology

Enable dynamic pricing & feedback

- Provide two- way communication with utility
- Provide customers with flexible access to usage data and prices
  - Understand usage patterns & their relationship to energy costs
- Track interval (e.g., hourly) usage data: measure, store, transmit
- Implement price responsive tariffs (dynamic pricing):
  - Time of use, critical peak pricing, real-time prices

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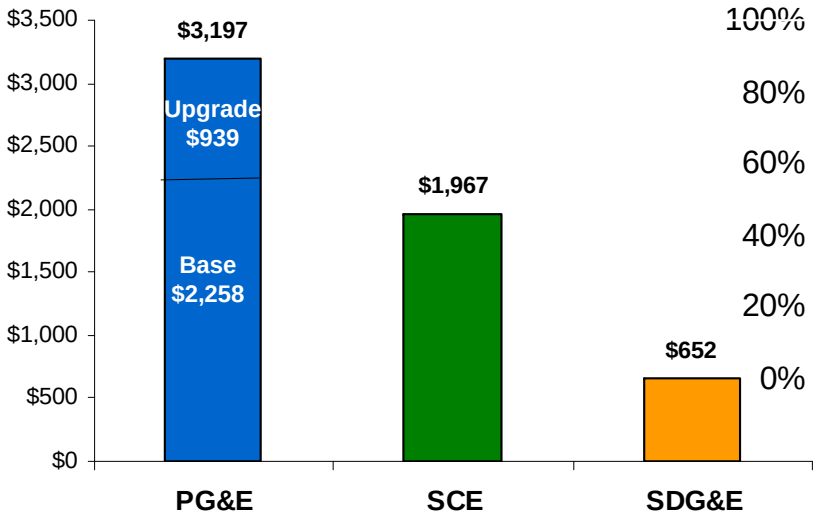
California Advanced Metering Synopsis (Residential, Small Commercial)

	Pacific Gas & Electric	San Diego Gas & Electric	Southern California Edison
# of Electric Meters	5.1M	1.4M	5.3M
# of Gas Meters	4.2M	0.9M	Gas Utility may connect to AMI
Costs Approved	$1.7B in July 2006	$0.6B in April 2007	-
Costs Pending Approval	$0.6B to upgrade	-	$1.7B
Deployment Schedule	2006 to 2012	2008 to 2011	2009 to 2012

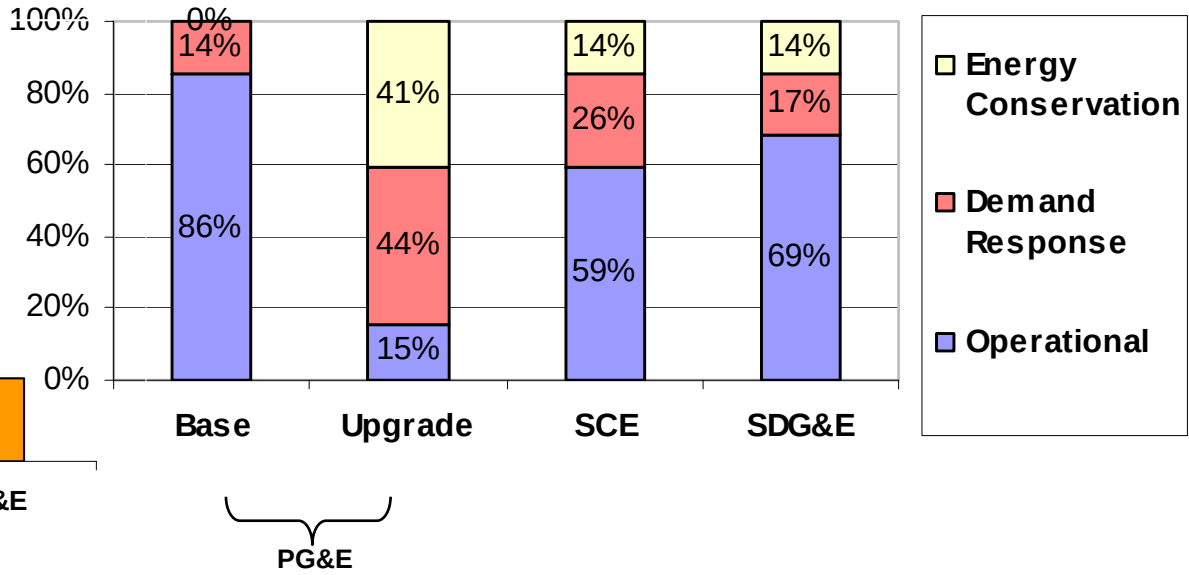
Note: “interval meters” for large customers >200kW already in place

AMI Business Case Summary

AMI Costs (PVRR)



AMI Benefits



(PVRR = Present Value Revenue Requirement)

Benefit/ Cost Ratio	1.08	1.06	1.02

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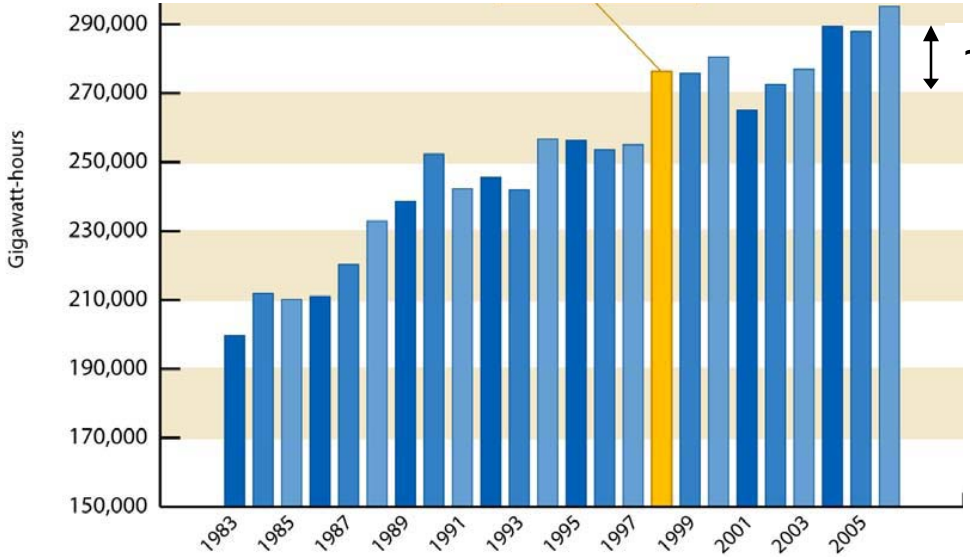
CPUC Regulatory Objectives behind AMI

- **Maximize potential societal benefits**
  - Operational Savings leading to bill savings
  - Improved Reliability / Service
  - Environmental benefits
- **Encourage Energy Conservation (Efficiency)**
- **Maximize Demand Response**
  - Particularly price responsive demand response

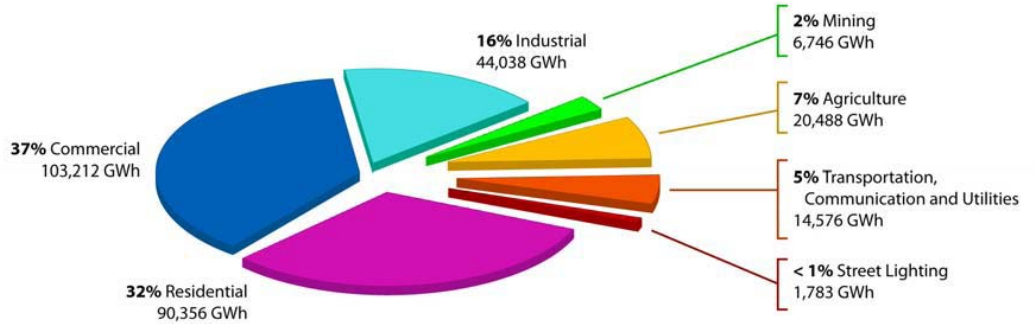
California's Electricity Supply / Demand

Electricity Generation



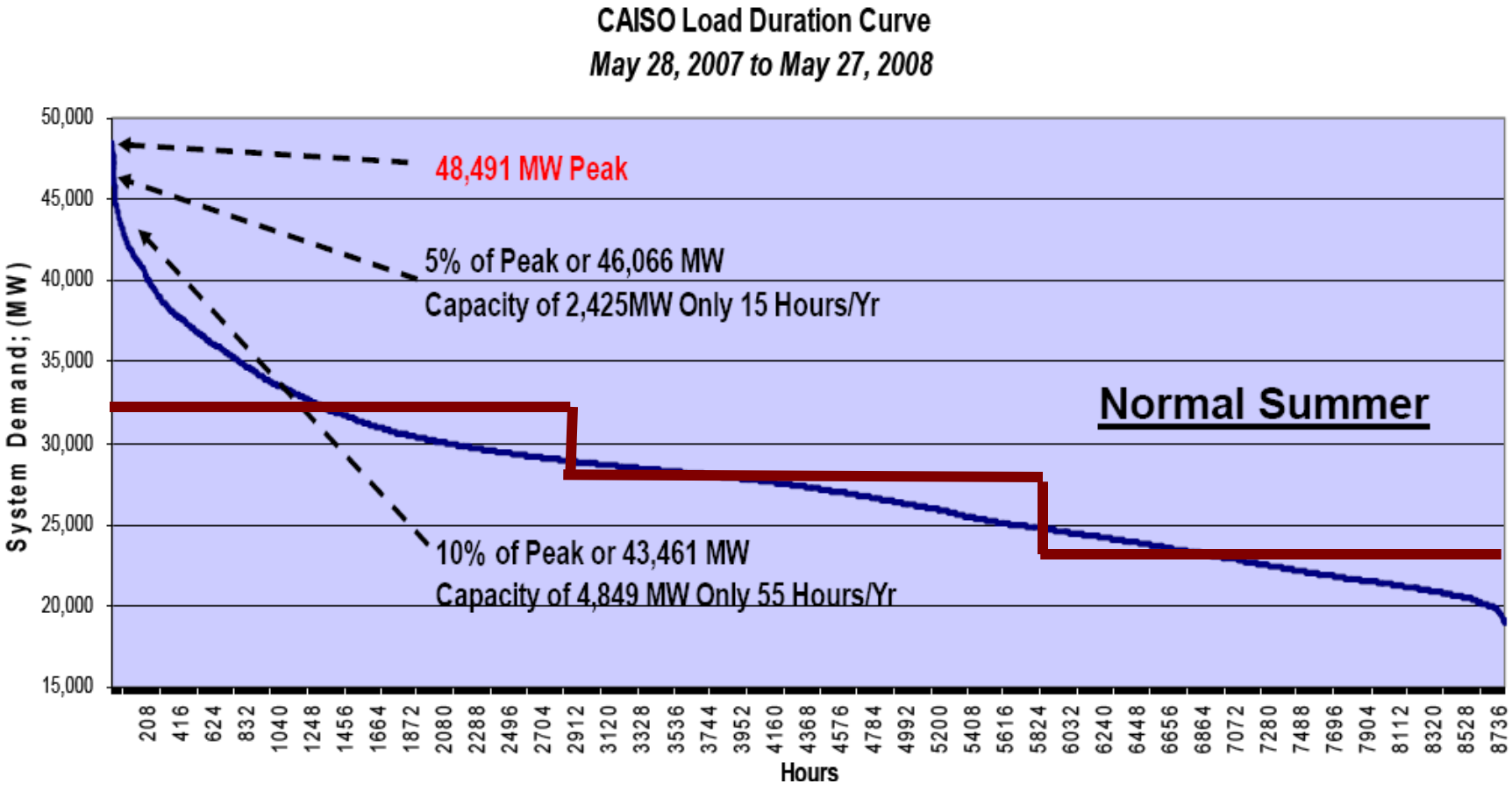
~ Equiv Four Avg Power Plants

Electricity Consumption by Sector (2006)



Source: California Energy Commission

California Hits Its Peak for Very Few Hours of the Year



One Year = 8760 Hours

Source: California ISO

Demand Side Rationale

- **To enable conservation & demand response, desirable for customers to be aware of:**
  - How much electricity is consumed, for what uses?
  - How much does it cost?
  - When does it cost more or less?
- **With Smart Meters, provide customers with opportunities to reduce and / or shift their electricity consumption**
  - optimize net benefits

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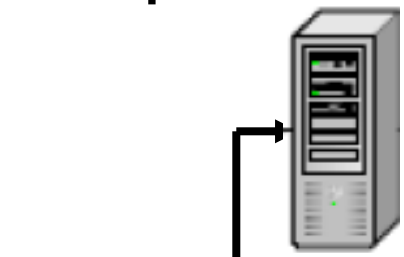
AB1X Price Constraints

- **For residential sector, retail electricity prices capped for up to 130% baseline consumption**
  - Cap extends to circa ~2020
  - Fixed tier pricing
- **Currently, the lowest tier prices are below cost of producing & distributing electricity**
- **Barrier to providing price signal to customers**

“The Last Yard!” (Inside the Home)

- **Utility deployment of Smart Metering system only extends up to the meter at the house**
- **No provision for In – Home Display (IHD) devices to provide real-time feedback**



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- Outage Mgmt.
- Load Control

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“The Last Yard!” (Inside the Home)

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- No provision for In – Home Display (IHD) devices to provide real-time feedback
- **Up to third party vendors to market Zigbee-based solutions to consumers**
- **What will consumers respond to?**
  - Display / device technology?
  - Information to display?
  - Control / programmable functions?
  - Cost of device?
  - Energy Management services?

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- **The Bigger Picture**

Smart Grid in California

- Digital
- Advanced Communications
- Sensors & Automation
- Predictive & Self-Healing
- Smart Meters
- Integrated (Distrib. Gen, Storage, PHEV)
- Interactive, Real-time info
- Standardized & Evolving

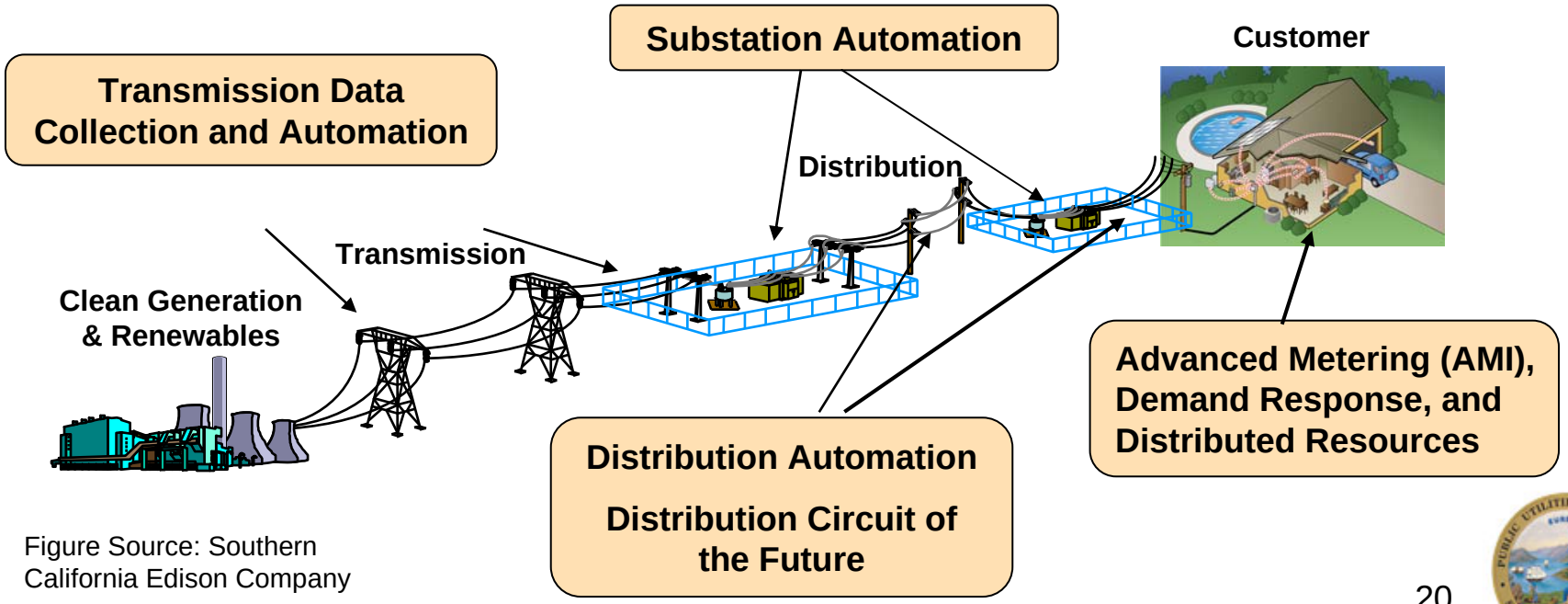
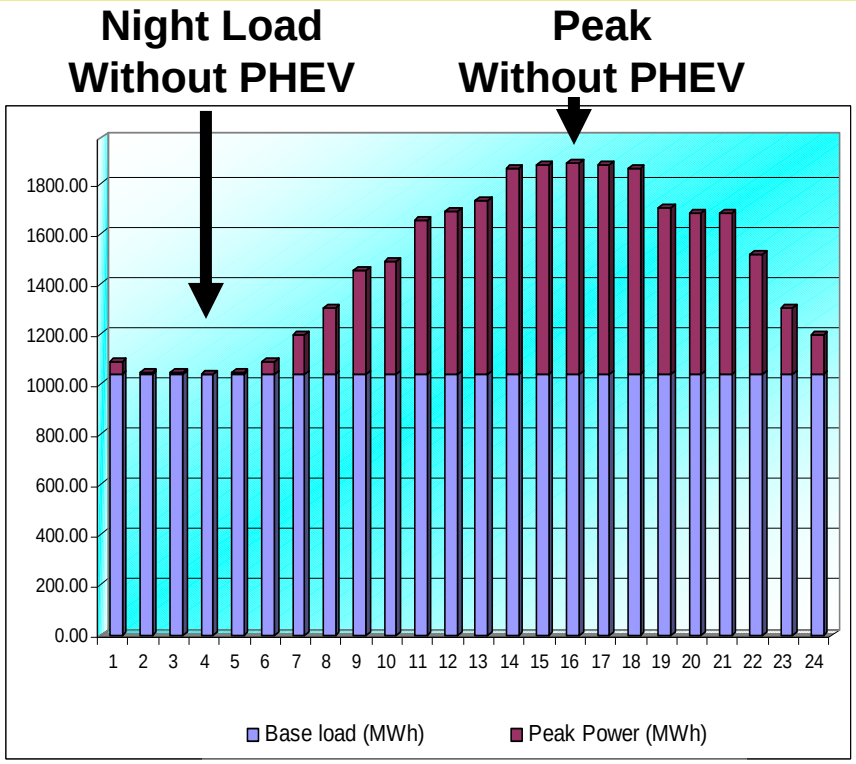
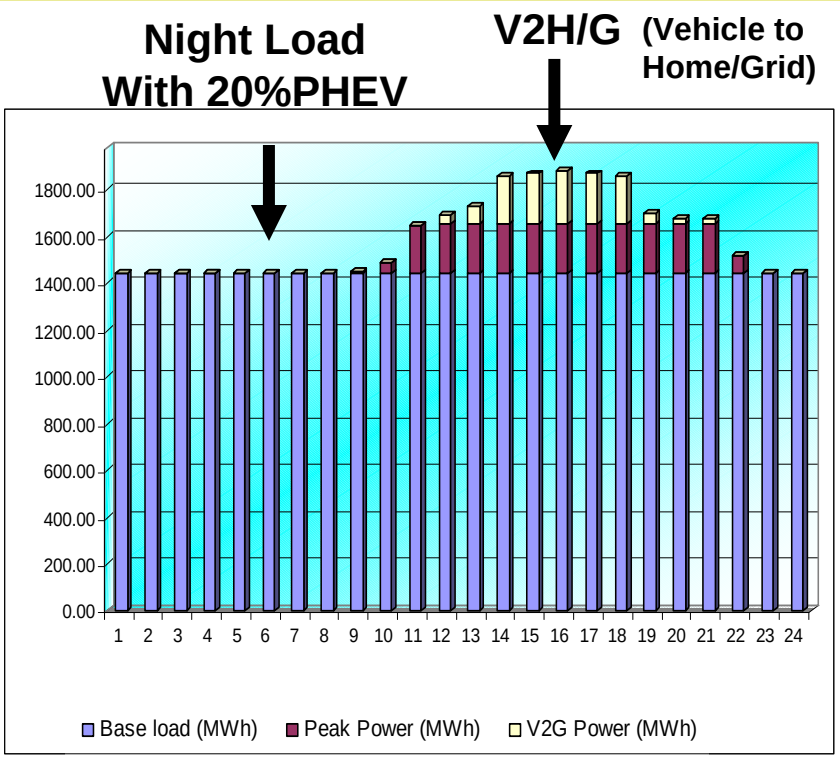


Figure Source: Southern California Edison Company

Example of What Smart Grid Can Achieve: 20% Penetration of PHEV Can Balance the Electric Grid





Energy available for the grid (V2G)	0	Mwh	Consumption without V2G	35300	Mwh	Total Base load before	24960	Mwh	Total Peak Power before	10340	Mwh
Energy use for recharging vehicles	4	Mwh	Consumption with V2G	37068	Mwh	Total Base load after	34560	Mwh	Total Peak Power after	2508	Mwh
Nb of vehicles	125000	#	Consumption increase	5.01	%	Base load increase	38.46	%	Peak Power decrease	75.74	%

Data and graphs for the Sacramento area are provided by Prof. Andrew A. Frank, University of Calif.-Davis and CTO of Efficient Drivetrains Inc.

California Smart Meter Policy & Deployment

Thank You

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