An Overview of
California Smart Meter Policy & Deployment

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California Public Utilities Commission (CPUC)
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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

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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 Management System

Data Management System

“LAN” (Proprietary 900 MHz Fixed Wireless)

“WAN” / Backend (Standard)

- Website
- Billing
- Outage Mgmt.
- Load Control
Two Methods to Provide Usage Feedback

Path 1: Internet (1-way, next day)

Path 2: HAN (2-way, real-time)

Smart Meter

Meter Communication Network

Website

IOU Data System

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)

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

Note: “interval meters” for large customers >200kW already in place
AMI Business Case Summary

AMI Costs (PVRR)


$3,197 $939 $2,258

$1,967 $1,967 $1,967

$652 $652 $652

PG&E SCE SDG&E

AMI Benefits

Energy Conservation

Demand Response

Operational

Benefit/Cost Ratio

PG&E

1.08 1.06 1.02

(PVRR = Present Value Revenue Requirement)
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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

CAISO Load Duration Curve
May 28, 2007 to May 27, 2008

- 48,491 MW Peak
- 5% of Peak or 46,066 MW
- Capacity of 2,425 MW Only 15 Hours/Yr

- 10% of Peak or 43,461 MW
- Capacity of 4,849 MW Only 55 Hours/Yr

Source: California ISO

One Year = 8760 Hours
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
California Smart Metering Overview

Cost / Benefits

Goals / Objectives

Challenges in Affecting Customer Behavior
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
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.

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

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