Sacramento Municipal Utility District’s EV Innovators Pilot

Lupe Jimenez

November 20, 2013
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Sacramento Municipal Utility District

Snapshot

Sacramento County in Northern California

Municipal Electric Utility
  • Governed by a Board of Directors

610,000 Customers
  • 540,000 Residential
  • 70,000 Commercial

Summer-Peaking Load (Air Conditioning)
  • Residential Peak: 4-7pm June-September
  • Peak load ~3000 MW, of which 400MW = 40 hours

Energy Mix
  • Hydro
  • Natural gas-fired generators
  • Renewable energy
  • Wholesale market
Pilot Plan
Background

SMUD Electric Vehicle (EV) Program began in 1989

A single EV TOU rate was created in 1993

• ~70 enrollments as of January 2013
• Provided insufficient cost recovery
• Provides insufficient transformer protection for projected EV Impacts
  – Off-peak starts at 8:00 p.m.
  – Weekends are off-peak

Anticipating ~30K EV’s in SMUD service territory by 2020

2009 SGIG funding provided opportunity to evaluate new options
At-a-Glance

Evaluate various rates and charging profiles, potential market for load control, rate sensitivity, EVSE distribution models, and considerations related to charging behavior. Offer PEV drivers a smart Level II EVSE with sub-meter and load management with automatic load reduction. Measure Level I charging.

Pricing plans include:
- Combined whole house and EV TOU for Level I customers
- Separately metered EV-only TOU with dynamic critical peak demand charge

- CUSTOMER SECTOR:
  Residential

- NUMBER OF CUSTOMERS: 215
  39 Whole House + EV Pricing Plan
  98 Self-Managed EV-only Pricing Plan
  60 SMUD-Managed EV-only Pricing Plan
  18 Load Data Only

- CUSTOMER BENEFITS: Reduced consumption and should see bill reduction from time-based pricing and demand response. No cost for equipment.

- CUSTOMER REQUIREMENTS: Installation, networking of equipment, demand response, load control, and dynamic or time-based rates.
## Pilot Schedule

<table>
<thead>
<tr>
<th>Key Milestone</th>
<th>Completion Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pilot Planning</td>
<td>March 1, 2013</td>
</tr>
<tr>
<td>Project Planning Documentation</td>
<td>May 11, 2012</td>
</tr>
<tr>
<td>Project Planning</td>
<td>November 21, 2012</td>
</tr>
<tr>
<td>IT Business Requirements</td>
<td>May 21, 2012</td>
</tr>
<tr>
<td>Process Development</td>
<td>March 1, 2013</td>
</tr>
<tr>
<td><strong>Implementation for DOE Evaluation</strong></td>
<td><strong>December 31, 2013</strong></td>
</tr>
<tr>
<td>Procure and Build ZigBee Controllable EVSE</td>
<td>February 21, 2013</td>
</tr>
<tr>
<td>Staff and Installer Training</td>
<td>April 2, 2013</td>
</tr>
<tr>
<td>Rate Design and Bill Programming</td>
<td>April 30, 2013</td>
</tr>
<tr>
<td>Recruitment</td>
<td>July 9, 2013</td>
</tr>
<tr>
<td>Installations</td>
<td>September 2013</td>
</tr>
<tr>
<td><strong>Evaluation</strong></td>
<td><strong>May 30, 2014</strong></td>
</tr>
<tr>
<td><strong>SMUD Implementation Continued</strong></td>
<td><strong>December 31, 2015</strong></td>
</tr>
</tbody>
</table>
Treatment Group Summaries
### Treatment Groups Side-by-Side

<table>
<thead>
<tr>
<th>Whole House (TG1)</th>
<th>Self-Managed (TG2)</th>
<th>SMUD-Managed (TG3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Level 1 (120V) charging only</td>
<td>• Up to Level 2 (120V-240V) charging</td>
<td>• Level 2 (240V) charging</td>
</tr>
<tr>
<td>• Single AMI meter monitors house and EV usage</td>
<td>• AMI TOU sub-meter on dedicated circuit monitors EV usage</td>
<td>• AMI TOU sub-meter on dedicated circuit monitors EV usage</td>
</tr>
<tr>
<td>• No participation in Conservation Days</td>
<td>• House is on standard tiered rate</td>
<td>• House is on standard tiered rate</td>
</tr>
<tr>
<td>• Wave 1: No initial incentive</td>
<td>• Participates in Conservation Days (Self-managed charging)</td>
<td>• Participates in Conservation Days (DRMS reduces to 1.4kW charging)</td>
</tr>
<tr>
<td>• Wave 2: Convenience cord-set valued at $595</td>
<td>• Wave 1: Installation of Meter Socket Box valued at ~$600</td>
<td>• Installation of Dedicated Circuit, Meter Socket Box, and Smart EVSE – total value ~$3,600</td>
</tr>
</tbody>
</table>
Whole-House EV Pricing Plan

The **EV Innovators Whole House Plan** is a great choice if you want your home and vehicle usage all in one pricing plan. This plan rewards you for charging your electric vehicle during off-peak times and you charge by plugging into a standard 120-volt outlet.

<table>
<thead>
<tr>
<th>Season</th>
<th>Off-Peak Times</th>
<th>On-Peak Times</th>
<th>Electricity Charges (¢ per kWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Winter Season</strong></td>
<td>10:00 p.m. - 4:00 p.m. daily</td>
<td>4:00 p.m. - 10:00 p.m. daily</td>
<td>$7.40¢</td>
</tr>
<tr>
<td><strong>Summer Season</strong></td>
<td>10:00 a.m. - 2:00 p.m. daily</td>
<td>2:00 p.m. - 4:00 p.m. weekdays, 7:00 p.m. - 10:00 p.m. weekdays, 2:00 p.m. - 10:00 p.m. weekends and holidays</td>
<td>$8.30¢, $14.70¢, $14.70¢</td>
</tr>
<tr>
<td></td>
<td><strong>Summer Super-Peak</strong></td>
<td>4:00 p.m. - 7:00 p.m. non-holiday weekdays</td>
<td>$27.30¢</td>
</tr>
</tbody>
</table>

System Infrastructure Fixed charge per month: $10.00
SeparatelyMeteredEVPricingPlans

The **EV Innovators Dedicated Meter Plan** is a great fit for you if you want to save money by shifting your charging to off-peak times, and if you currently charge your electric vehicle on a 120-volt or 240-volt circuit. Participants on this pricing plan require a sub-meter. If you don’t have one, we’ll install one for you.

<table>
<thead>
<tr>
<th>Winter Season</th>
<th>Electricity Charges (¢ per kWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>October 1 through May 31</td>
<td></td>
</tr>
<tr>
<td>Winter Off-Peak: 10:00 p.m. - 4:00 p.m. daily</td>
<td>6.00¢</td>
</tr>
<tr>
<td>Winter On-Peak: 4:00 p.m. and 10:00 p.m. daily</td>
<td>13.00¢</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Summer Season</th>
<th>Electricity Charges (¢ per kWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>June 1 through September 30</td>
<td></td>
</tr>
<tr>
<td>Summer Off-Peak: Midnight - 2:00 p.m. daily</td>
<td>6.00¢</td>
</tr>
<tr>
<td>Summer On-Peak and Conservation Days: 2:00 p.m. - 4:00 p.m. daily</td>
<td>30.00¢</td>
</tr>
<tr>
<td>Summer Super-Peak and Conservation Days: 7:00 p.m. - Midnight daily</td>
<td>42.60¢</td>
</tr>
<tr>
<td>Conservation Day Premium Charge (per event) (max 12 events per summer):</td>
<td></td>
</tr>
<tr>
<td>First 2 kW during Conservation Day</td>
<td>no charge</td>
</tr>
<tr>
<td>All kW greater than 2 kW between 2:00 p.m. and Midnight</td>
<td>$3.50/kW</td>
</tr>
</tbody>
</table>

**Metering Service Charge per month**

$3.00
## SMUD-Managed vs. SMUD-Managed Separately Metered EV Pricing Plans

<table>
<thead>
<tr>
<th>Self-Managed Option</th>
<th>SMUD-Managed Option</th>
</tr>
</thead>
<tbody>
<tr>
<td>With the self-managed option, it’s up to you to decide when you charge your vehicle and whether or not you want to avoid peak usage and Conservation Day Premium Charges.</td>
<td>When you choose the SMUD-managed option, we’ll install, at low or no cost to you, a 240-volt charging station that we can automatically adjust on Conservation Days to save you money.</td>
</tr>
</tbody>
</table>

Most electric vehicles come equipped with easy-to-use charging timers, so most drivers find it’s easy to plan their charging times. For EV Innovators Participants who do not already have a meter socket box and sub-meter, we’ll install one at little or no cost.
Points of Interest
Technology

• No EVSE meeting our requirements existed. Partnered with Clipper Creek to develop the model.
• Smart meter (Zigbee) communicates directly to EVSE or Repeater
• Just under 50% success rate for sustained connectivity (Meter to EVSE)
  – Poor signal quality (often range related), even with range extender
  – Problem with power supply circuit to communications module
  – Interoperability issues between ZigBee radio and communications module in EVSE (weak packet recovery methodology)
  – Commissioning oversights (provisioning, HAN certs, etc.)
• Tested nine vehicles to confirm interoperability with DRMS:
  – 2 Passed all tests
  – 4 Passed Standard Use Case:
  – 3 Did pass testing:
• Conservation Day Messaging through DRMS to TeleVox to Customer
  – Messaging delivered via Email, Text, or Call/Voicemail
Premium Charge (Demand Charge)

- “Conservation Days” are days (no more than 12 per summer) where electricity use is projected to be extremely high and you may incur Premium Charges.

- “Premium Charge” is an additional charge for the electricity you use exceeding 2 kilowatts (kW) between 2:00 p.m. and midnight. You can only incur a Premium Charge on a Conservation Day. If you program your vehicle to charge after midnight and before 2:00 p.m., you will never pay a Premium Charge.
## Premium Charge Example

<table>
<thead>
<tr>
<th>Conservation Day</th>
<th>Amount Joe Charged, 2 p.m. - midnight</th>
<th>The first 2kW is FREE</th>
<th>kW eligible for Premium Charge</th>
</tr>
</thead>
<tbody>
<tr>
<td>July 2</td>
<td>6.6kW</td>
<td>-2kW</td>
<td>4.6kW</td>
</tr>
<tr>
<td>July 10</td>
<td>6.6kW</td>
<td>-2kW</td>
<td>4.6kW</td>
</tr>
<tr>
<td>July 11</td>
<td>6.6kW</td>
<td>-2kW</td>
<td>4.6kW</td>
</tr>
<tr>
<td>July 12</td>
<td>6.6kW</td>
<td>-2kW</td>
<td>4.6kW</td>
</tr>
</tbody>
</table>

Joe’s total July kW eligible for Premium Charge: 18.4kW*

Joe will be billed a Premium Charge of $63 for July. (18kW multiplied by $3.50).

*Total kW is rounded to the nearest whole number.
Early Observations

Operations

Development and Testing
- Close partnership for EVSE development and testing equipment is critical
- Plan detailed lab and system tests of EVSE with SSN, SEP 1.1, and DRMS
- Use Standard Use Case Testing to assess which vehicles will be able to fully participate in load control events
- Lab testing of HAN equipment doesn’t replace field testing.
- Technology is not yet mature

Notifications
- Conservation Day messaging should be simple and clear
- Conservation Day messaging should include a QA step to confirm receipt

Work Flows and Processes
- Create detailed work flows/processes documentation
- Asset tracking should be established prior to the first delivery.
- Inventory entry should be electronic to avoid errors (batch upload or scan)
- Interoperability between sub-meter and EVSE was limited (~50% connectivity)
- HAN certification tracking for meters to be verified before scheduling installs

Field Work
- Installations took longer than anticipated
- Difficulty identifying event overrides from failed load-management communications for billing purposes.
- Use staff for notifications and marketing to test timing and delivery of notifications.
- Troubleshooting visits are time consuming for employee and customer
Early Observations

Customer Experience

Participation
- Customers seem to be willing to avoid peak, participate in programs, and use their on-board scheduling application.
- Customers are willing to allow SMUD to assist in load management – this was the first group to fill.
- Whole-house was the most difficult plan for recruitment. Most were recruited using a significant incentive.
- Sub-metering appears to be the biggest hurdle for the self-managed plan. It became over-subscribed after sub-meter rebate was offered.

Support and Communications
- Customer support through recruitment and installation is extensive.
- Support staff must be extremely well informed. Standard call routing is likely to be inadequate.
- Use of community EV groups as a marketing channel was successful.
- Require customers to provide multiple channels for Conservation Day notifications to avoid failed delivery.
- Remind customers to ensure their vehicle clock is set correctly and for the correct time zone when programming a charging schedule.
- Conservation Day messaging should be simple, clear, and include a QA step to confirm receipt.
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Lupe Jimenez
Sr. Project Manager, Smart Grid and R&D
Lupe.Jimenez@smud.org