Sacramento Municipal Utility District's EV Innovators Pilot

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Powering forward. Together.

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Agenda

- SMUD Snapshot
- Pilot Plan
  - ❖ Background
  - ❖ At-a-Glance
  - ❖ Pilot Schedule
- Treatment Group Summaries
  - ❖ Treatment Group Side-by-Side
  - ❖ Whole-House EV Pricing Plan
  - ❖ Separately Metered EV Pricing Plans
  - ❖ Load Data Tracking (No EV Rate)
- Points of Interest
  - ❖ Technology
  - ❖ Premium Charge (Demand Charge)
  - ❖ Early Observations

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Sacramento Municipal Utility District Snapshot

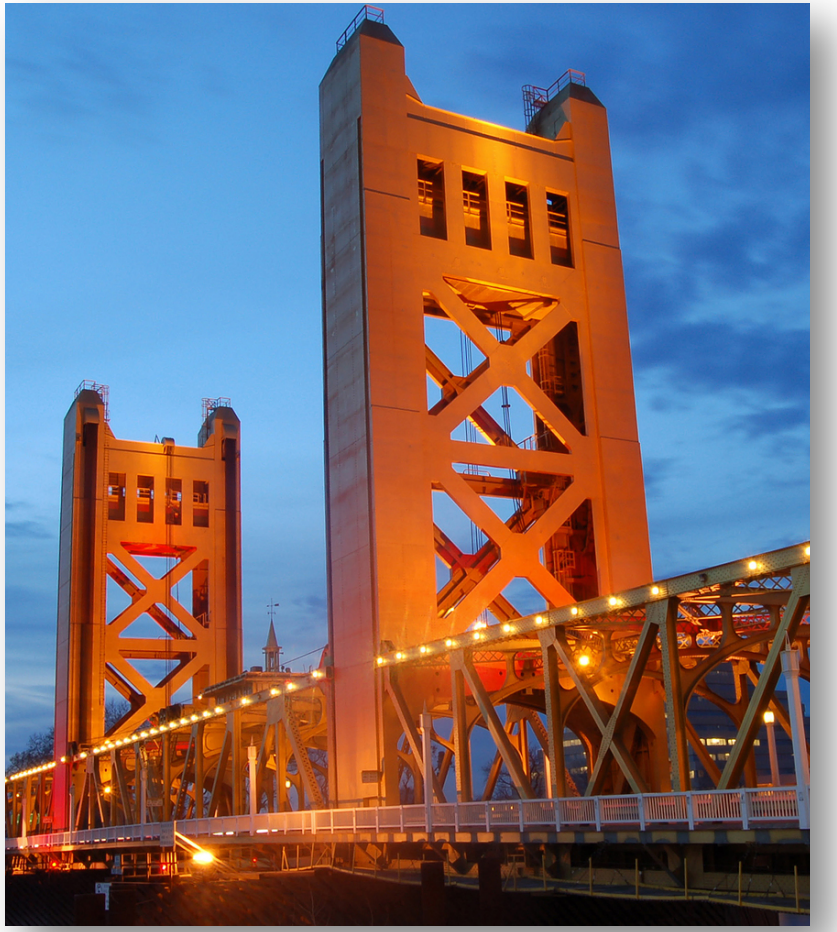
Sacramento County in Northern California

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



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Pilot Plan

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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

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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.

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Pilot Schedule

Key Milestone	Completion Date
Pilot Planning	**March 1, 2013**
Project Planning Documentation	May 11, 2012
Project Planning	November 21, 2012
IT Business Requirements	May 21, 2012
Process Development	March 1, 2013
Implementation for DOE Evaluation	**December 31, 2013**
Procure and Build ZigBee Controllable EVSE	February 21, 2013
Staff and Installer Training	April 2, 2013
Rate Design and Bill Programming	April 30, 2013
Recruitment	July 9, 2013
Installations	September 2013
Evaluation	**May 30, 2014**
SMUD Implementation Continued	**December 31, 2015**

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Treatment Group Summaries

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Treatment Groups Side-by-Side

Whole House (TG1)

- Level 1 (120V) charging only
- Single AMI meter monitors house and EV usage
- No participation in Conservation Days
- Wave 1: No initial incentive
- Wave 2: Convenience cord-set valued at $595

Self-Managed (TG2)

- Up to Level 2 (120V-240V) charging
- AMI TOU sub-meter on dedicated circuit monitors EV usage
- House is on standard tiered rate
- Participates in Conservation Days (Self-managed charging)
- Wave 1: Installation of Meter Socket Box valued at ~$600
- Wave 2: If already has sub-meter, received $599 rebate

SMUD-Managed (TG3)

- Level 2 (240V) charging
- AMI TOU sub-meter on dedicated circuit monitors EV usage
- House is on standard tiered rate
- Participates in Conservation Days (DRMS reduces to 1.4kW charging)
- Installation of Dedicated Circuit, Meter Socket Box, and Smart EVSE – total value ~$3,600

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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.*

Winter Season *October 1 through May 31*		**Electricity Charges** *(¢ per kWh)*
Winter Off-Peak:	10:00 p.m. - 4:00 p.m. daily	7.40¢
Winter On-Peak:	4:00 p.m. - 10:00 p.m. daily	13.00¢

Summer Season *June 1 through September 30*		**Electricity Charges** *(¢ per kWh)*
Summer Off-Peak:	10:00 a.m. - 2:00 p.m. daily	8.30¢
Summer On-Peak:	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	14.70¢
Summer Super-Peak:	4:00 p.m. - 7:00 p.m. non-holiday weekdays	27.30¢

System Infrastructure Fixed charge per month	$10.00

Separately Metered EV Pricing Plans

*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.*

Winter Season *October 1 through May 31*		**Electricity Charges** *(¢ per kWh)*
Winter Off-Peak:	10:00 p.m. - 4:00 p.m. daily	6.00¢
Winter On-Peak:	4:00 p.m. and 10:00 p.m. daily	13.00¢

Summer Season *June 1 through September 30*		**Electricity Charges** *(¢ per kWh)*
Summer Off-Peak:	Midnight - 2:00 p.m. daily	6.00¢
Summer On-Peak and Conservation Days:	2:00 p.m. - 4:00 p.m. daily 7:00 p.m. - Midnight daily	30.00¢
Summer Super-Peak and Conservation Days:	4:00 p.m. - 7:00 p.m. daily	42.60¢
Conservation Day Premium Charge (per event) *(max 12 events per summer)*:		
First 2 kW during Conservation Day		no charge
All kW greater than 2 kW between 2:00 p.m. and Midnight		$3.50/kW
Metering Service Charge *per month*		**$3.00**

SMUD-Managed vs. SMUD-Managed Separately Metered EV Pricing Plans

Self-Managed Option

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.

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.

SMUD-Managed Option

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.

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Points of Interest

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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

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Premium Charge (Demand Charge)

- "**Conservation Days**" are days (no more than12 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 neverpay a Premium Charge.

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Premium Charge Example

Conservation Day	Amount Joe Charged, 2 p.m. - midnight	The first 2kW is FREE	kW eligible for Premium Charge
July 2	6.6kW	-2kW	4.6kW
July 10	6.6kW	-2kW	4.6kW
July 11	6.6kW	-2kW	4.6kW
July 12	6.6kW	-2kW	4.6kW

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.*

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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

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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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U.S. Department of Energy Disclaimer

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