SDG&E Electric Vehicle activities

Managing load and storage while maximizing customer value

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Mission & objectives

Our mission:

• Contribute to an excellent customer experience and support the growth of electric transportation while ensuring the safe, reliable and efficient integration of plug-in vehicle (PEV) loads with the grid.

Objectives:

• **Charging infrastructure** – available and convenient
• **Charging pricing** – to encourage off-peak charging
• **Utility system integration** – efficient, safe and reliable
• **Market development** – education and outreach
SDG&E Electric Vehicle activities
Overview

• San Diego area PEV adoption

• Infrastructure roll-outs
  – EV Project and NRG

• Pilots
  – EV Rate and Technology Study
  – EV Demand Response (Grid-to-Vehicle, G2V)
  – Stationary battery aggregation and control
  – Smart Transformers / Transformer Impact Studies
  – Electric Vehicle Service Provider (EVSP) Smart Grid Development Project
  – Identification of value, for PEV drivers and all utility customers

• Challenges – technical, organizational and policy

1.) San Diego Zoo vehicles and heavy equipment only; does not include trailers, stationary equipment or Wild Animal Park Fleet.
San Diego-area PEV adoption
And infrastructure roll-outs

Plug-in Vehicles
- Approximately 2,500 PEVs\(^1\) as of 12/31/2012 – estimate, based on OEM sales data, and on rate-assignments in SDG&E’s billing system (e.g. EV-conversion vehicles)

Charging equipment
- **EV Project**
  - 365 public-access EVSE at 106 locations are operational
  - 887 Residential
  - 15 DC Fast Chargers in progress (two installed and operational)
- **NRG settlement (eVgo)**
  - Minimum of 15 public “stations”\(^2\)
  - 10,000 “make-ready” at 1,000 locations across California
  - Preliminary city permitting discussions have commenced

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1.) Includes 300 Car2Go car-sharing vehicles
2.) eVgo “Freedom Stations” to include two DC Fast Charger and one Level 2 unit.
Plug-in Vehicles and the grid
A holistic view – one step at a time...

Safe
Reliable
Efficient
Customer experience
2012 PEV charging
Proportion by TOU period

- The majority of charging is occurring in the Super-Off Peak period.
- Larger differentials between day and night price appear to be influencing more persistent Super-Off Peak PEV charging.

Experimental rates approved by the CPUC in June of 2010

• Compelling evidence that TOU pricing is effective in encouraging Off-Peak Pricing.

**EV Demand Response (Grid-to-Vehicle, G2V)**

*Dynamic rates and influence over charging...*

- Eight ~1 kW and two ~8 kW plug-in vehicle charging units
  - Variable power\(^1\), based on **driver-specified** maximum cost and real-time price
  - PEV drivers authorize and activate at one **place** (at the kiosk)
  - Storage charge/discharge coordinated with site-specific or remote conditions.

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1. 1 kW "Level 1" units operate when price is below driver-specified maximum price; 8 kW Level 2 units' power is infinitely variable between a manufacturer-specified amperage range.
Flexible Demand Initiative
Stationary battery aggregation and control

- Develop bi-directional (charge/discharge) controls for aggregating several stationary battery storage systems into a single, virtual resource.

- First step toward integration of utility and/or CAISO control systems with *mobile* energy storage systems (PEVs).
  - 3rd party public access charging
  - Fleet & employee battery-integrated fast charger
  - Second Use of EV Batteries in Stationary Applications (NREL, DOE, CCSE, UCSD, AeroVironment, KN Grid)

- SDG&E will learn how to use these “virtual storage systems” to provide grid support services (e.g. frequency regulation) in order to reduce customer costs resulting from use of more traditional resources.
Smart Transformers

- Transformer data are collected and transmitted every 12 minutes.
- SDG&E will determine most effective methods for using Smart Transformer monitoring and control in order to minimize distribution-system impacts from incremental load, thereby reducing requirements for distribution system upgrades.

Ten units in the field now; approximately 700 more through 2013

Initial deployments are on residential transformers, with one or more PEVs.
Electric Vehicle Service Provider (EVSP)  
Smart Grid Development Project

- SDG&E / EVSP cooperation
- Implementation and assessment of open-standards communication protocols
- Influence and control of PEV charging based on Demand Response signals and/or varying price... while ensuring customers needs are met.
- May include integration with Home Energy Management systems in PEV drivers’ homes.
- Observations of behavior-change will be applied to development of new DR programs and tariff designs.
Identification of value
For PEV drivers and all utility customers

- SDG&E is continuing to assess the sources and amounts of value, and costs, associated with various G2V/DR and V2G implementations.
  - Value must exceed tangible (i.e. battery-life degradation) and intangible (e.g. real and perceived inconvenience) costs.

Illustrative battery cost example:

\[
\frac{($300 \times 24 \text{ kWh})}{(8 \text{ years} \times 8 \text{ kWh/day})} = 0.31 \text{ / kWh}
\]
Challenges

• Utility ownership of EVSE
  – Fleet and employees only – limits ability to increase sample size for behavioral studies.

• Ownership and responsibility for the meter and data (in the EVSE or vehicle)
  – Ensuring meter-data integrity, for billing and settlement

• Emerging equipment suppliers
  – Safety-certification
  – Reliability and compatibility
  – Open vs. proprietary standards
  – Warranty; financial strength; changing business models

• Rapid change
  – e.g. CHAdeMo > SAE Combo connector
APPENDIX
Growing repository of useful public data
Simple math reveals interesting conclusions

- **Public data:** The EV Project
  - **San Diego**
    - 657 Nissan LEAFs; 153 Chevy Volts
    - 300 Smart EDs (Car2go)
    - 581 Residential units; 39,091 events; 329 MWh
    - 253 Public L2; 15,375 events; 159 MWh
    - Highest demand ~1.1 MW\(^1\)
    - 2,046 MWh; 227,990 charging events (60% Car2go)
  - **All cities**
    - 1,818 public L2 and 39 DCFC
    - 296 L2 MWh 38,975 L2 events
    - 9.41 DCFC MWh across and 1,644 events
    - Highest demand 2.6 to 3.6 MW
    - 4,719 LEAFs, 1,052 Volts and 300 Smart EDs

- If all 2,400 San Diego PEVs\(^2\) were contributing:
  - \(\frac{1.1\text{ MW}}{2,400\text{ PEVs}} = 0.458\text{ kW per PEV}\)
  - If this trend continues, 200,000 PEVs could result in \(0.458 \times 200,000 = 92\text{ MW of new load}\)^1

- If only EV Project PEVs were contributing:
  - \(\frac{1.1\text{ MW}}{900\text{ PEVs}} = 1.222\text{ kW per PEV}\)
  - If this trend continues, 200,000 PEVs could result in \(1.222 \times 200,000 = 244\text{ MW of new load}\)^1

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Report period: July 2012 through September 2012
1.) Occurs at approximately 1:30 AM weekdays
2.) SDG&E estimate, as of Dec. 2012 – PEVs in SDG&E service territory


9 kWh / charge
7.6 kWh / L2 charge
5.7 kWh / DCFC charge
0.43 - 0.59 kW / PEV
~2.6 MW

~3.6 MW

Weekday ~3.6 MW