L.A. AFB V2G PILOT PROJECT

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Project Overview

- 6 DoD bases with 500 PEVs announced, including China Lake CA
  third phase will be 1000 additional vehicles of total non-tactical fleet of \(~200,000\)
  (mostly low usage medium duty vehicles)
- about half L.A. AFB fleet will bid into CAISO Regulation (Aug 2013)
- Three L.A. funding sources:
  - DOD \(~2+ M\)$ for vehicles, charging stations, and construction
  - ESTCP \(~1.75 M\)$ for fleet management, communications, & optimization
  - CEC \(~1 M\)$ for 10-15 sedans and building integration capability
- first vehicles + EVSEs by Aug 2013
- hoping for a full year of data collection through mid-2014
- key research questions:
  - can an all-electric fleet meet mission requirements
  - can regulation market revenue close PEV cost gap
Why Relevant?

- between PEV-microgrid interaction a likely key component
- PEV batteries valuable storage
- PEV charging-discharging controllable and fast responding
- vehicle to grid (V2G) a precursor
to microgrid to megagrid (m-μ2MG)
- controlled microgrids will be participants in ISO markets
- function at scales consistent with current grid practice
Regulation

Regulation rectifies tiny discrepancies between load and 5-minute real time dispatch

- receive an operating point instruction and respond within 4 sec.
- continuous response during the award period
- requires capability to sustain output for
  DA: 1 h, HA: 30 min, NGR-REM: 15 min

Operating Reserves

Operating Reserves, Spin and Non-Spin, respond when a contingency event occurs to restore balance.

- respond within 10 minutes
- most events 10-30 mins. long
- able to sustain output for 30 min or award length
A symmetric combined regulation award has an average value of $16.04/MW-h.

On average Regulation is about 2.5 times more valuable than Spinning Reserve, and approximately 16 times more valuable than Non-Spinning Reserve.

MW-h is the unit used for ancillary awards. It is defined as one MW of power capacity held in reserve for one hour (it is not a unit of energy).

10-15 k-vehicles could provide all of SoCal’s regulation requirement.

### CAISO RegU+D Prices
(Apr 2009 – Mar 2012)

<table>
<thead>
<tr>
<th></th>
<th>Avg</th>
<th>Std Dev</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>[$/MW-h]</td>
<td>[$/MW-h]</td>
<td>[$/MW-h]</td>
<td>[$/MW-h]</td>
</tr>
<tr>
<td>Regulation Up</td>
<td>9.13</td>
<td>9.63</td>
<td>0.00</td>
<td>545.27</td>
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<tr>
<td>Regulation Down</td>
<td>6.91</td>
<td>5.63</td>
<td>0.00</td>
<td>79.55</td>
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<tr>
<td>Spinning Reserve</td>
<td>6.61</td>
<td>8.02</td>
<td>0.00</td>
<td>440.92</td>
</tr>
<tr>
<td>Non-Spinning reserve</td>
<td>0.97</td>
<td>4.34</td>
<td>0.00</td>
<td>416.33</td>
</tr>
</tbody>
</table>

Source: Ventyx Velocity Suite
3 Required Technologies

Singapore

BOSCH
Invented for life

Santa Rita Jail

Participating Load Pilot

BOSCH
Invented for life

Akuacom

Utility Operator Geographic View

Akuacom provides technology and services for Automated Demand Response (Auto-DR).

Solutions News Resources About Us

Akuacom - Auto Demand Response http://www.akuacom.com/
Utility Operator Geographic View

Akuacom provides technology and services for Automated Demand Response (Auto-DR).... solutions and services for Automated Demand Response (Auto-DR).

At the core of the AFB system is Akuacom's Demand Response Automation Server (DRAS), which manages the interactions between the system operator, DRAS, and other participants such as the base retail meter, ISO PEV meter, and charging stations.

Trip information is shared with the eMobility (fleet mgmt.) system, which includes trip data and energy schedules. This information is used to optimize energy consumption and discharging instructions for electric vehicles (EVs). The DER-CAM (optimizer) system helps forecasters and foresters to plan for energy demand and supply.

The system includes various components such as scheduling coordinator, independent system operator (ISO), and interactions with energy schedules, bid information, metering readings, and other system data.
Data Machinery

Plug-In Vehicles

BOSCH (eMobility)
Availab. & SOC
Availab. & Req.
Vehicle data & status

Berkeley Lab (DER-CAM)
Charge – Discharge Instructions
Charge-Discharge Schedules
Schedules

Akuacom (DRAS)
Awards, Instructions, Settlements, Prices
RTP - 2 Prices
5-Day ahead RTP-2 Prices

SCE (S. C.)
Awards, Instructions, & Settlement

CAISO

Phase 1 – Static Test
Phase 2 – Daily Cycle
(Bids at 10:00, Schedule at 20:00 etc)
Phase 3 – Continuous Optimization
(actual reg up/down participation)
Aerial View of L.A. AFB

EV parking and charging

Meter and outdoor comm. cabinet

comm. room
L.A. AFB Views
## 18 Vehicle Test Fleet

### EV1-EV6
- **Model:** Nissan LEAF
- **Number:** 6
- **Energy Capacity:** 24 kWh
- **Max Charge Power:** 15 kW
- **Max Discharge Power:** 15 kW

<table>
<thead>
<tr>
<th>Total Energy Capacity</th>
<th>1074 kWh</th>
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<tbody>
<tr>
<td>Total Charge Power</td>
<td>540 kW</td>
</tr>
<tr>
<td>Total Discharge Power</td>
<td>540 kW</td>
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</table>

### EV7-EV12
- **Model:** Auto Port Van
- **Number:** 6
- **Energy Capacity:** 35 kWh
- **Max Charge Power:** 15 kW
- **Max Discharge Power:** 15 kW

<table>
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<tr>
<th>Minimum Resource Size</th>
<th>500 kW</th>
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<tr>
<td>Minimum Bid</td>
<td>100 kW</td>
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<tr>
<td>Minimum Bid Increment</td>
<td>10 kW</td>
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</table>

### EV13-EV18
- **Model:** Smith Electric Truck
- **Number:** 6
- **Energy Capacity:** 120 kWh
- **Max Charge Power:** 60 kW
- **Max Discharge Power:** 60 kW

![Image of EV1, EV7, and EV13 vehicles]
Bidirectional Power

1. Nissan LEAF using CHAdeMO 
   Leading, Environmentally friendly, Affordable, Family car

2. AC propulsion technology

3. J1772 combo connector

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2. AC propulsion technology

3. J1772 combo connector
## EV Results Summary

<table>
<thead>
<tr>
<th>Energy Costs ($)</th>
<th>22.65</th>
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<tbody>
<tr>
<td>Power Costs ($)</td>
<td>0</td>
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<tr>
<td><strong>Reg Revenue ($)</strong></td>
<td></td>
</tr>
<tr>
<td>Up D1</td>
<td>83.01</td>
</tr>
<tr>
<td>Dn D1</td>
<td>24.53</td>
</tr>
<tr>
<td>Up D2</td>
<td>85.37</td>
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<tr>
<td>Dn D2</td>
<td>24.55</td>
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<tr>
<td><strong>Energy limit (kWh)</strong></td>
<td></td>
</tr>
<tr>
<td>High D1</td>
<td>1039</td>
</tr>
<tr>
<td>Low D1</td>
<td>214.8</td>
</tr>
<tr>
<td>High D2</td>
<td>1039</td>
</tr>
<tr>
<td>Low D2</td>
<td>214.8</td>
</tr>
</tbody>
</table>

![Graphs and charts related to EV results and energy costs](http://www.akuacom.com/)

Akuacom provides technology and services for Automated Demand Response (Auto-DR).
Project Challenges

- regulatory barriers
  need special tariff approval (hybrid wholesale-retail)
  CAISO NGR rules under development
- equipment availability and cost
  bidirectional vehicles and specialized charging stations
  OCPP & CHAdeMO
- security
  cyber security approval
  physical security of vehicles

- CAISO minimums
  > additional vehicles
  > charging-discharging control
- diversity of equipment
- CHAdeMO & OCPP support – TARDEC requirements
- cyber security
- general contracting issues, e.g. CEC title, 14th LEAF, etc.
- . . . . THIS IS AN R&D PROJECT
Thank you!

http://microgrid.lbl.gov/