SDG&E's Wholesale Market Integration Pilot

December 12, 2016

OPRA Project Overview and Key Objective

Project Overview

- Throughout 2014 and 2015, SDGE partnered with Shell to aggregate modulated EV charging load and energy storage systems for participation in the CAISO's energy and ancillary service markets.

SDG&E's Key Objective

- "Learn by doing"
  - Obtain working knowledge of the procedures and requirements for virtually aggregated distributed energy resources (DER) -- like EVs and energy storage -- to interconnect with and directly participate in the CAISO's markets.
  - Begin to assess/quantify the value (and risks) of DER participating in CAISO markets. Ability to quantify overall cost effectiveness is increasingly necessary given California's storage mandates, distributed generation and clean transportation objectives.

History and Asset Overview

History

- Shell approached SDG&E in late 2013 seeking a U.S. utility partner to investigate feasibility/desirability of providing managed charging services to EV fleet owners. Primary focus on exploring B2B service opportunities for EV fleet owners
  - Charging optimization to lower customer energy costs
  - Market integration to provide additional revenue streams
  - Shell concurrently ran similar trials in Europe
- Three project phases
  - Phase 1: Customer acquisition and equipment install
  - Phase 2: PDR registration and energy market participation
  - Phase 3: Ancillary service certification and market participation
- Project timeline: Q1 2014 - Q4 2015

High Level Roles and Responsibilities

SDG&E's Responsibilities

- Interconnect project assets and enable market participation utilizing the CAISO's Proxy Demand Resource (PDR) platform.
  - Challenge: at project's inception, **no** AES or EVs aggregations actively participating in the CAISO markets.
  - Required developing new understanding of operational issues related to integrating DER into both the utility system and the CAISO markets
- Act as market interface: Bid and settle transactions on Shell's behalf.

Shell's Responsibilities

- Optimize project assets and create hourly market transaction schedule.
- Control and dispatch project assets in accordance with CAISO dispatch schedule.
- Supply incremental storage systems to increase capacity and enable ancillary service (A/S) market participation

Key Questions for SDG&E

- What is required to aggregate, control and integrate BTM DER into the market?
- What are the costs, barriers and potential limitations?
- Is *direct* participation in the markets beneficial, if so what needs to evolve from both regulatory and market design perspectives to foster increased integration and participation?

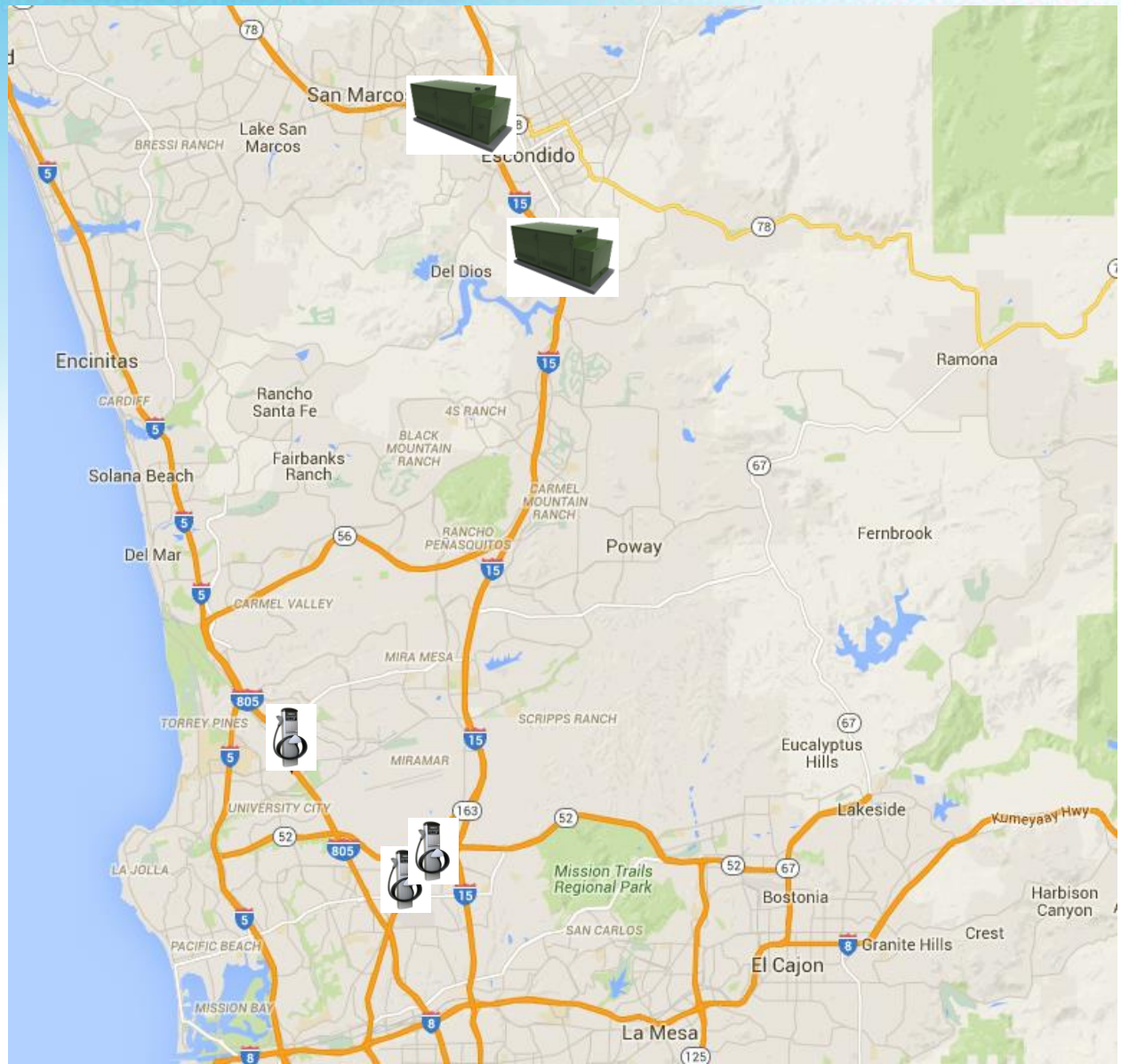
Answers are necessary to *accurately evaluate* future growth opportunities and potential efficiencies from DER.

Project Assets

- EV site 1: Fleet operations
  - 10 EV chargers/10 participating vehicles. ~100 kW average charging demand
- EV site 2: Fleet operations
  - 8 EV chargers/10 participating vehicles. ~40 kW average charging demand
- EV site 3: Workplace charging (non-fleet)
  - 10 EV chargers/20 participating vehicles. ~50 kW average charging demand.
- AES site 1
  - 50 kW/88 kWh
- AES site 2
  - 200 kW/400 kWh
- AES site 3
  - 200 kW/400 kWh

Total Project Capacity: ~640 kW

Site Map


San Marcos
Lake San Marcos
BRESSI RANCH
Escondido
Del Dios
Encinitas
CARDIFF
Rancho Santa Fe
4S RANCH
BLACK MOUNTAIN RANCH
Fairbanks Ranch
Solana Beach
Del Mar
CARMEL MOUNTAIN RANCH
RANCHO PENASQUITOS
Poway
Ramona
Fernbrook
CARMEL VALLEY
MIRA MESA
TORREY PINES
SCRIPPS RANCH
MIRAMAR
Eucalyptus Hills
Lakeside
Kumeyaay Hwy
UNIVERSITY CITY
LA JOLLA
Mission Trails Regional Park
Bostonia
Harbison Canyon
Crest
Granite Hills
SAN CARLOS
El Cajon
PACIFIC BEACH
MISSION BAY
La Mesa

Project Achievements

Project achievements:

- Project on-line from October 2014 through November 2015. Demonstrated ability to remotely control aggregated AES and EVs for market participation and customer benefit.
  - October 2014: Began actively bidding into the market as a PDR. Become the first utility in California to bid and dispatch EVs into the CAISO's Day-Ahead and Real-Time energy markets.
  - December 2014: Certified to provide Non-spinning Reserves
  - May 2015: Certified to provide Spinning Reserves. Resource become the first PDR in the CAISO certified to provide Spinning Reserves.
  - Actively bid into the market through November 2015. Received consistent energy, non-spin and spinning reserve awards and dispatches.

Observations

- There are no regulatory or market barriers to achieving this use case
  - Aggregated, behind-the-meter storage and EV charging can participate in the markets and provide value to customers.
  - For PDR resources, the CAISO's processes are well-defined and accessible
- Technical and economic challenges remain
  - Multiple integration points are required to enable resource aggregation and market participation; this creates costs and increases potential failure points.
  - In this pilot, costs associated with direct market integration exceeded revenue earned through direct market participation.
    - Limited energy resources (like storage or EVs) cannot participate in all hours
    - Baseline performance evaluation and Net Benefits Test requirements impact bidding strategies
    - Telemetry required for A/S participation adds costs

Integration Challenges

Resource Control & A/S Telemetry